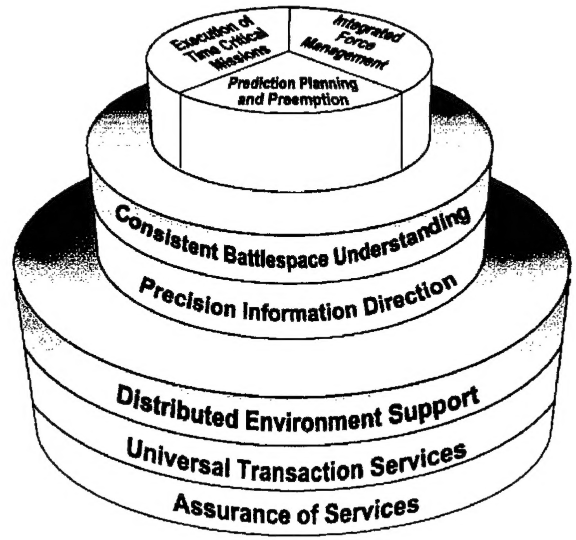

Advanced Battlespace Information System (ABIS)

Task Force Report

Volume VI

Supporting Annexes

Director of Command, Control, Communications, and Computers (Joint Staff)

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May 1996

Advanced Battlespace Information System (ABIS)

Task Force Report
Volume VI

Supporting Annexes

May 1996

Preface

This is Volume VI of the final report of the Advanced Battlespace Information System (ABIS) Task Force. The entire final report is organized into six separately bound volumes:

I. Executive Summary

II. Major Results

III. Battle Management Working Group Report

IV. Sensor-to-Shooter Working Group Report

V. Grid Capabilities Working Group Report

VI. Supporting Annexes

This volume, Supporting Annexes, was prepared by the ABIS Integration Team. These annexes provide more detail on key aspects of the integrated framework described in Volumes I and II to provide a context for the framework and to integrate the results from the three working groups (Volumes III, IV, and V).

Foreword

Volume VI of the ABIS Final Report is organized into six annexes. Annex A describes the methodological approach used by the ABIS Task Force and the various future operational contexts considered. Annex A forms the basis for determining likely future operational and command and control concepts. Annex B provides the detailed mapping of operational capability, critical C2 functions, and technology needs. Annex B integrates the detailed work of the three working groups into a consistent assessment of the current science and technology program that serves as the basis for an overall set of recommended technology initiatives leading to the Task Force's conclusions and recommendations regarding technology initiatives. Annex C provides a brief discussion of the ABIS construct from a system's perspective and addresses key opportunities and challenges at the systems level. Annex D addresses the key issue of progressing beyond the Task Force's work to the fielding and assimilation of technological capabilities in a system and operational context. This annex advocates an important process change to ensure that operational and technical activities will remain coupled as ABIS evolves. Annex E provides administrative information regarding the creation of the task force, its organization for work, and its membership. Annex F is a glossary of key acronyms.

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Annex A. Methodology and Operational Context

Methodology and Operational Context

This annex addresses analytic and future operational considerations that formed the basis for the command and control systems perspective of the ABIS Task Force. The content of this annex shaped the detailed analysis addressed in Annex B.

Objectives of ABIS

Goals:

- Ensure That the S&T Program for C4I Systems Is Aligned With Joint Vision 2010
- Develop a Strategic Framework for Related Architectural, Planning, and Programmatic Efforts

Derived Objectives:

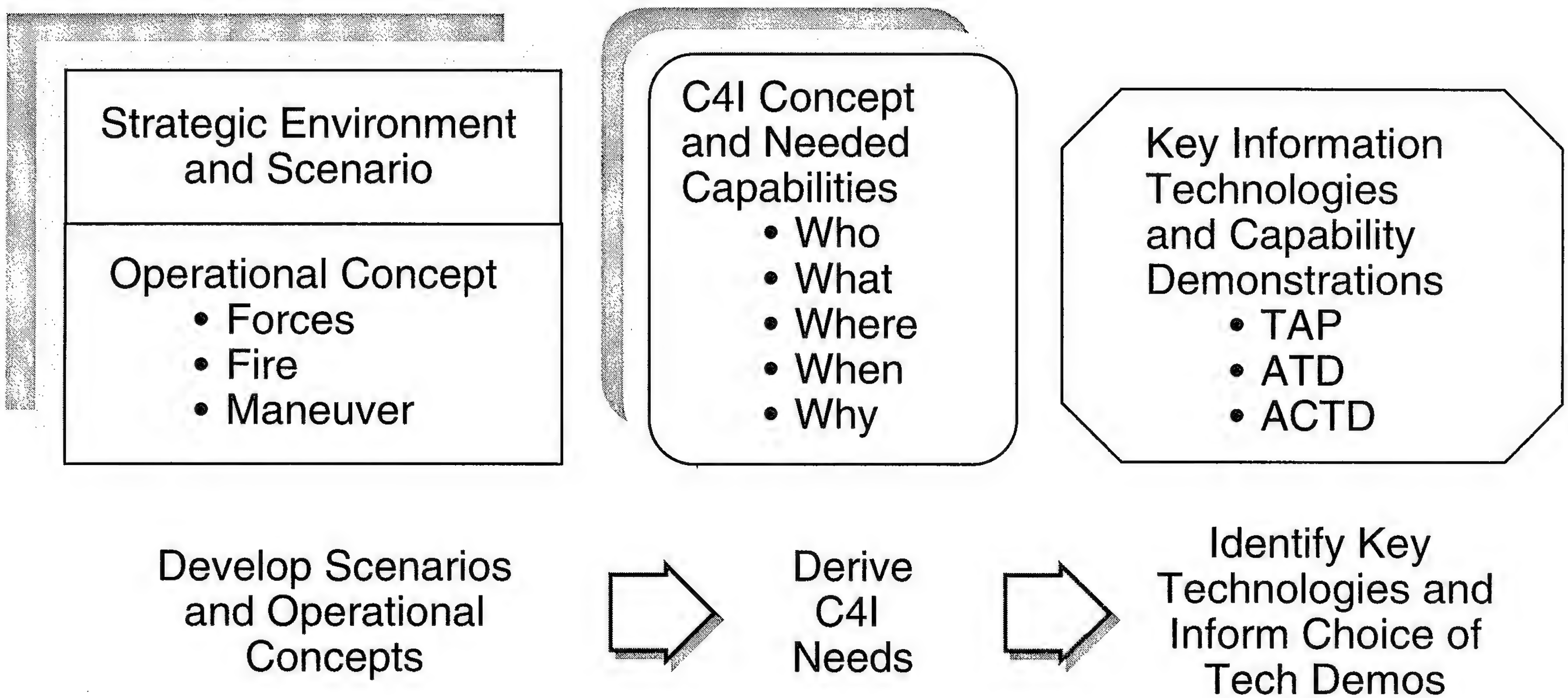
- Identify Important Required Command and Control Operational Capabilities and Associated C4I System Technology Initiatives for an Advanced Battlespace Information System
- Identify Follow-on Actions Needed To Ensure the Timely Evolution of These Capabilities

Objectives of ABIS

The Advanced Battlespace Information System (ABIS) Task Force had two overarching goals. First, to ensure that the science and technology (S&T) program for command and control is aligned with Joint Vision 2010. Second, to provide a strategic framework for considering future C4I systems that leaders in the operational and technological communities could use. The strategic framework had to reflect the operational demands important to the warfighters, as reflected through the Joint Chiefs of Staff. It also had to reach a level of detail useful to those planning technology developments under the guidance of the Undersecretary of Defense for Acquisition.

This study had two key derived objectives. The first was to identify the command and control concepts that could support future operational needs and then to tie those to technological developments needed to enable critical functions that current C2I systems lack. The methodology for that process is the primary subject of this annex. The second derived objective was to identify actions beyond the scope of this study that would be needed to create an actual ABIS system, for example, the creation of detailed architectures or of programmatic plans. This topic is discussed in Annex D.

Linking Operational Concepts and Key Technologies and Demonstrations



Linking Operational Concepts and Key Technologies and Demonstrations

The logical flow of the ABIS study methodology starts with a description of the future national security environment, together with a set of diverse scenarios involving the use of military forces. Based on Joint Vision 2010, the study investigates force-level operational concepts. These operational concepts center around the use of information to guide some form of precision engagement. The scenarios and operational concepts supply detail to develop the ABIS concept, that is, where in the world, which force elements are connected, with what timeliness, to what information, and to accomplish which tasks.

From the description of these future operational concepts and the scenarios they are embedded in, the study then derived required command and control concepts and capabilities. These are the command and control capabilities needed to support the force-level operational concepts.

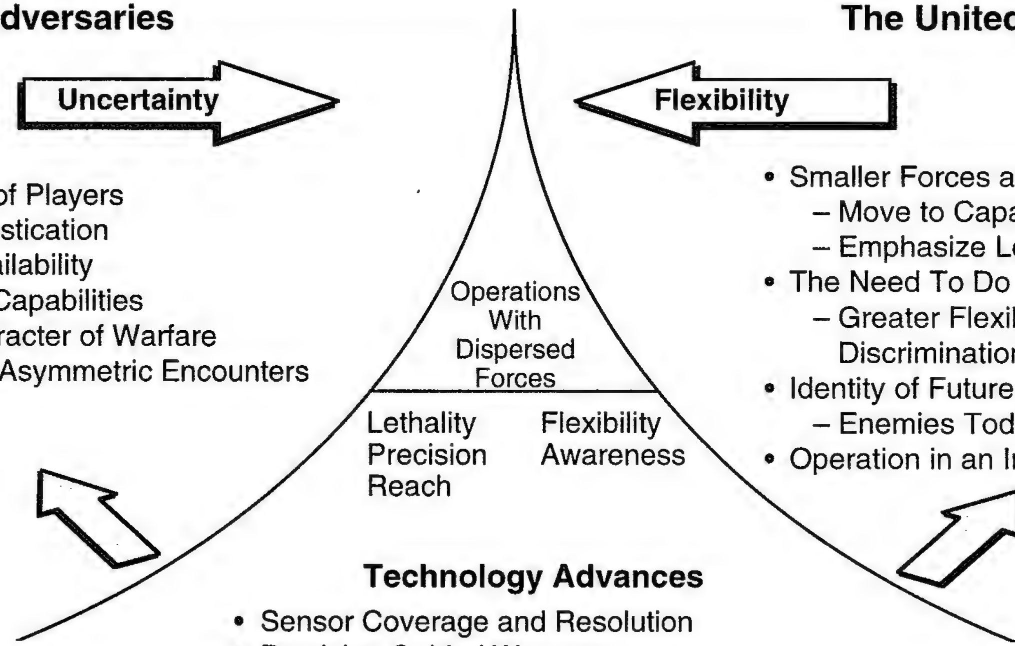
These needed capabilities were compared with current systems and ongoing programs to identify areas of limitation. Critical functions to overcome those limitations were then defined, and enabling technologies were identified.

The Future National Security Environment

An Era of Dynamic Changes, Constrained Resources, and Widely Varied and Uncertain Adversaries Demands Greater Flexibility and Discrimination

Potential Adversaries

- Wider Variety of Players
- Growing Sophistication
  - Market Availability
- More Diverse Capabilities
- Changing Character of Warfare
  - Deliberate Asymmetric Encounters



The United States

- Smaller Forces and Budgets
  - Move to Capability-Based Force Structure
  - Emphasize Leadership and Initiative
- The Need To Do More With Less
  - Greater Flexibility, Precision, and Discrimination
- Identity of Future Allies Uncertain
  - Enemies Today—Friends Tomorrow
- Operation in an Information Warfare Environment

Technology Advances

- Sensor Coverage and Resolution
- Precision Guided Weapons
- Information Systems (Commercial and DoD)
- Broader Range of Desired Weapons Effects
- Stealth and Signature Reduction

Capitalizing Quickly on Emerging Technology To Develop New Operational Capabilities Is Key

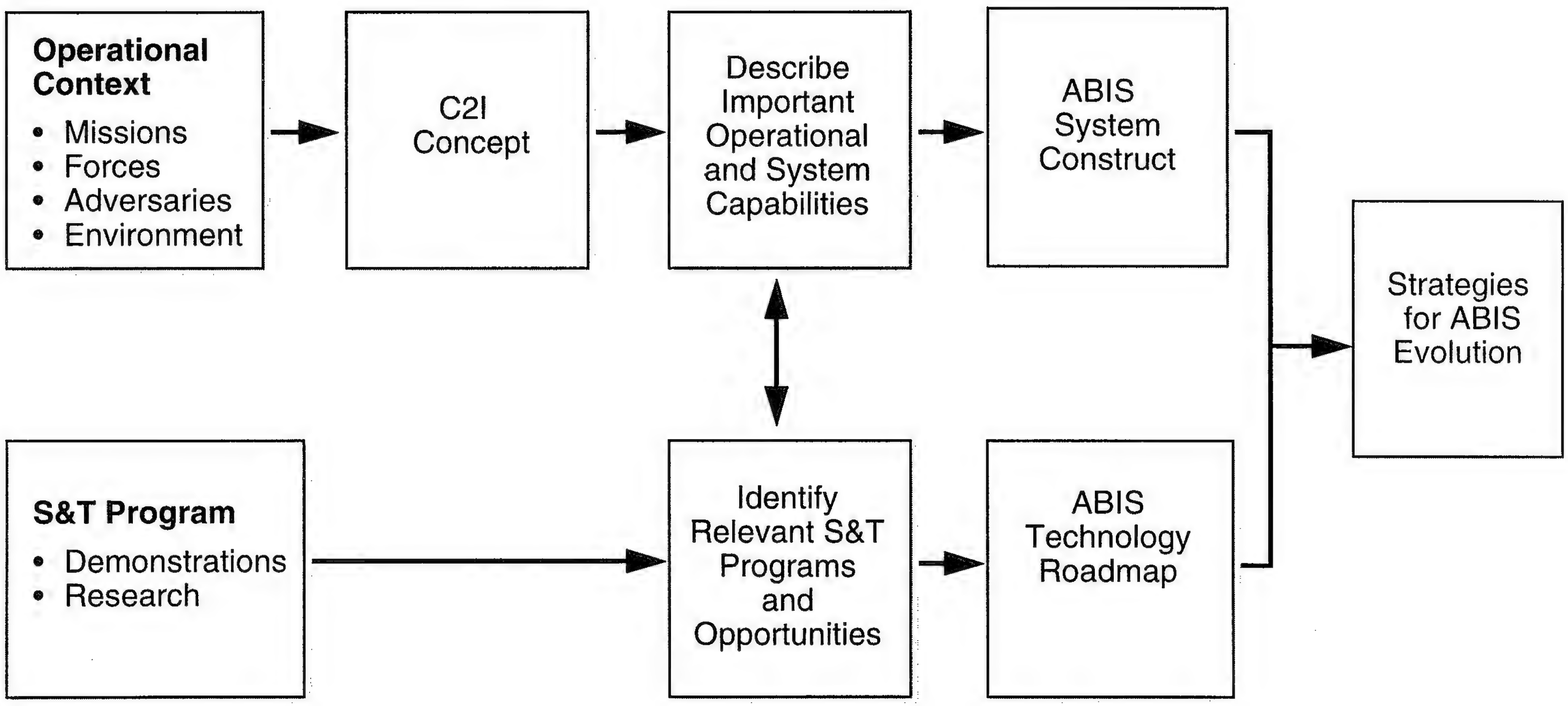
The Future National Security Environment

U.S. forces will face major challenges in the future national security environment, which will be characterized by change and uncertainty. They will have to deal with a broader range of sophisticated adversaries and often more than one simultaneously in geographically separated locales. In addition, this will have to be done with a smaller force structure as dictated by current budget reductions. Maintaining military supremacy in this global context requires a capability-based force structure that can be applied with flexibility, precision, and discrimination as well as an increased emphasis on leadership and initiative.

This challenge will be met in the context of an ongoing revolution in military affairs for which technological advances form one of the major drivers in leading to significant improvement in battlespace awareness, reach, precision, and lethality, and in dictating greater dispersal of forces to ensure their survivability. These trends, combined with improved information systems, will form the foundation for information-based warfare. In addition, if performed properly, this can be the basis on which the United States can be more effective with a smaller force.

The worldwide proliferation of advanced technologies means that our potential adversaries are increasing their level of sophistication and will also participate in the revolution in military affairs. Therefore, it is crucial that the United States be able to rapidly capitalize on emerging technologies to develop and implement new operational concepts. This is vital to the United States' ability to stay on the leading edge of this ongoing revolution in military affairs and to be able to maintain military advantage.

Task Force Methodology



ABIS Study Methodology

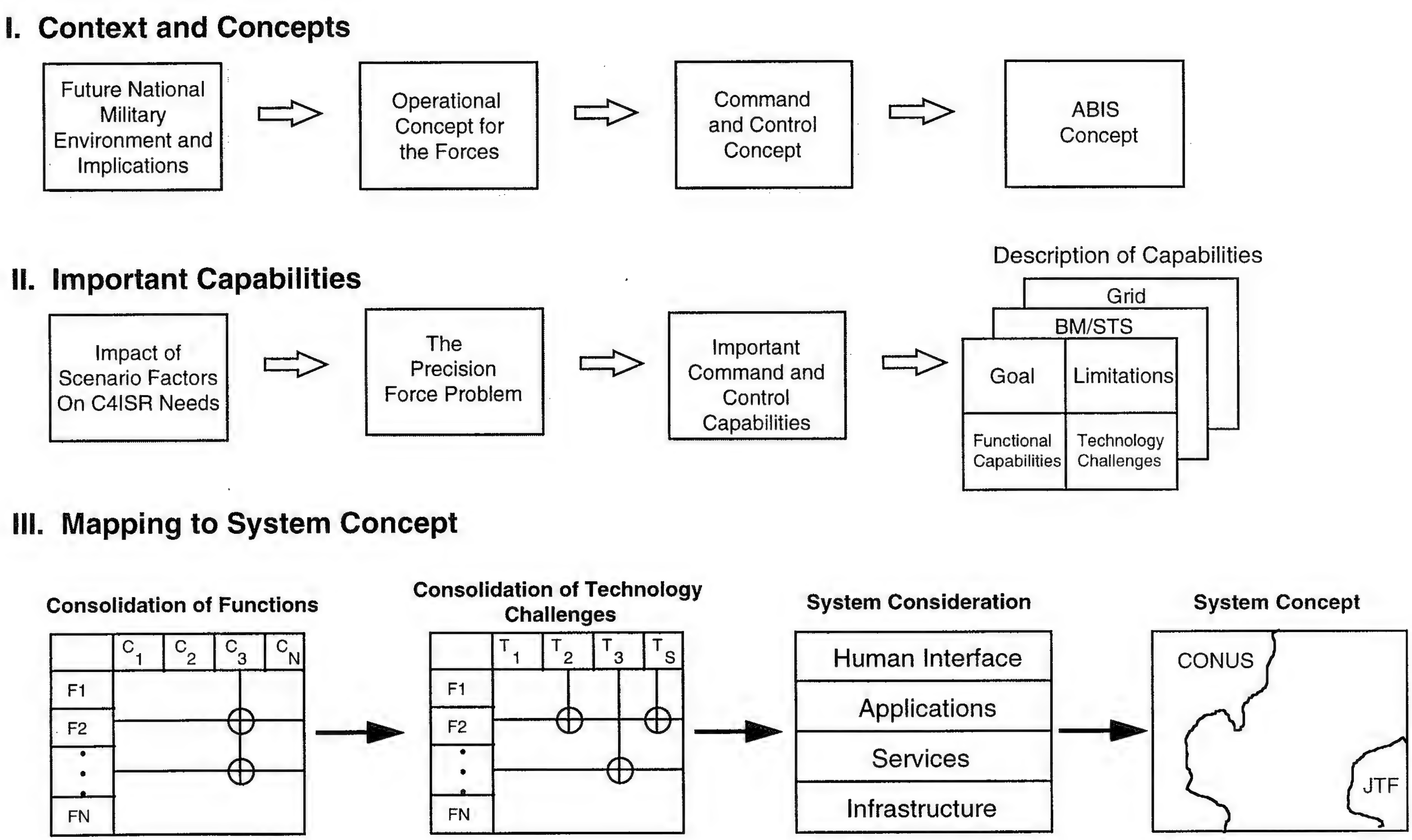
At a detailed level, the ABIS study had two concurrent and interacting threads: an operational/systems thread from operational context through system concept, and a science and technology (S&T) thread from S&T program through S&T roadmap generation. Throughout this process, there was extensive iteration of products between the working groups and the Integration Team. This approach was adapted from the Mission Oriented Approach to C4ISR analysis employed successfully in the 1980s to analyze strategic, theater, and tactical C4ISR issues.

To initiate the operational/systems aspect, the Integration Team characterized and assessed the operational context. It was necessary to develop a common point of departure for the study team by formulating demanding scenarios (as characterized by the mission, forces, adversaries, and operational environment) and assessing those scenarios to establish important capability benchmarks. The individual working groups then developed related operational and command and control concepts for their functional areas based on desired operational capabilities and relative ability of enabling technologies. Some of the working groups developed specific vignettes to study certain operational aspects in detail. Also in several areas, quantified measures of merit were derived from the scenarios. By assessing these concepts, the working groups identified key residual limitations of current capability* and technology challenges. Subsequently, the Integration Team (with the working groups) completed this thread of analysis by consolidating across the key operational activities, functions, and systems to create integrated operational and technical perspectives of the proposed ABIS system.

To initiate the science and technology aspect, the working groups were given characterizations of the existing and proposed S&T program. By comparing these data with an intermediate product from the operational/systems thread (i.e., key residual limitations and technology challenges), the working groups achieved two goals: Identified those S&T programs and demonstrations that are consistent with selected ABIS capability objectives, and identified and characterized those S&T programs and demonstrations that need to be initiated to satisfy selected residual ABIS capability limitations. Subsequently, the Integration Team with the working groups concluded this aspect of the analysis by generating an S&T roadmap that identified recommended S&T programs and demonstrations as a function of time (i.e., near-, mid-, and long-term) in the context of anticipated maturity of the needed technologies.

* In identifying these capabilities, current fielded capability and capabilities of near-term systems in acquisition were considered.

Detailed Steps in Methodology



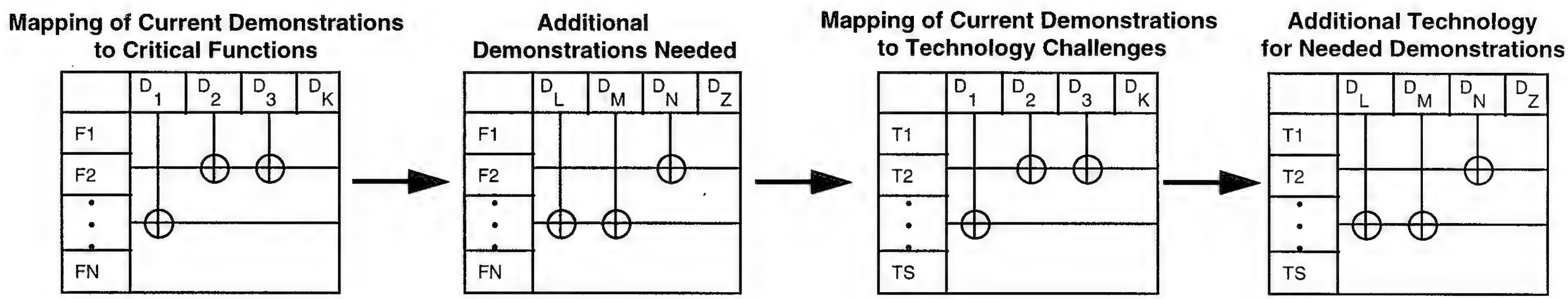
Detailed Steps in Methodology

The ABIS effort can be viewed as five activities. The first activity (I) defines the context and the general concepts that shaped the entire ABIS study. This starts with a vision of the future and goes on to describe the Advanced Battlespace Information System at the most general level. The second activity (II) developed more detailed views of different future or individual scenarios and derived the important operational capabilities that an ABIS must supply, taking into account likely capabilities, at different stages of maturity, of enabling information technologies. Ultimately, this second activity yielded both key functional capabilities and technology challenges. The last step of that detailed linkage is treated in detail in Volumes III, IV, and V of this report, which are working groups' results. In each of those volumes, the results are summarized in a series of four-part figures that list each goal, the current limitations blocking each goal, the set of critical functional capabilities needed to overcome the limitations, and the technology challenges to achieve the functional capabilities.

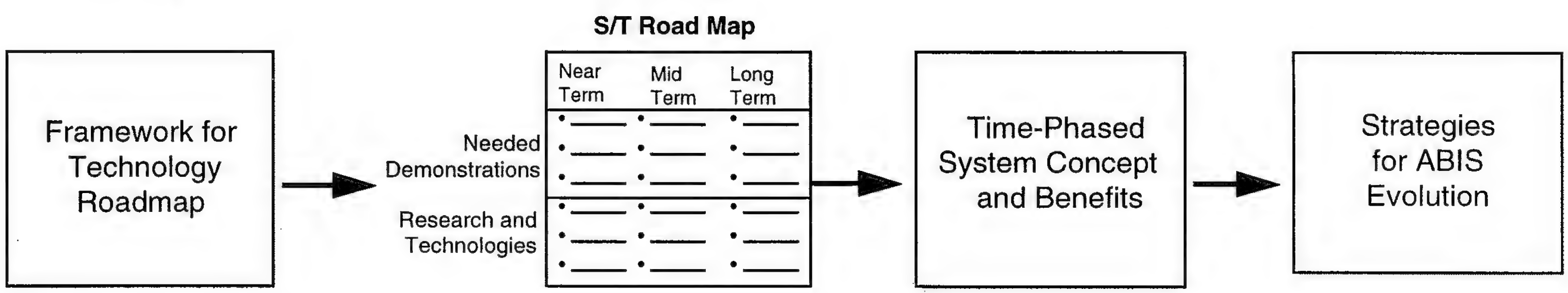
Activities I and II are the subject of this annex and correspond roughly to the initiation phase of the operational thread described previously (excluding the four-part figures included in Volumes III, IV, and V). The third activity (III) maps the capabilities to the general system concepts they imply, and is covered in detail in Annexes B and C.

Detailed Steps in Methodology *(Continued)*

IV. Mapping of S&T Program



V. Roadmap



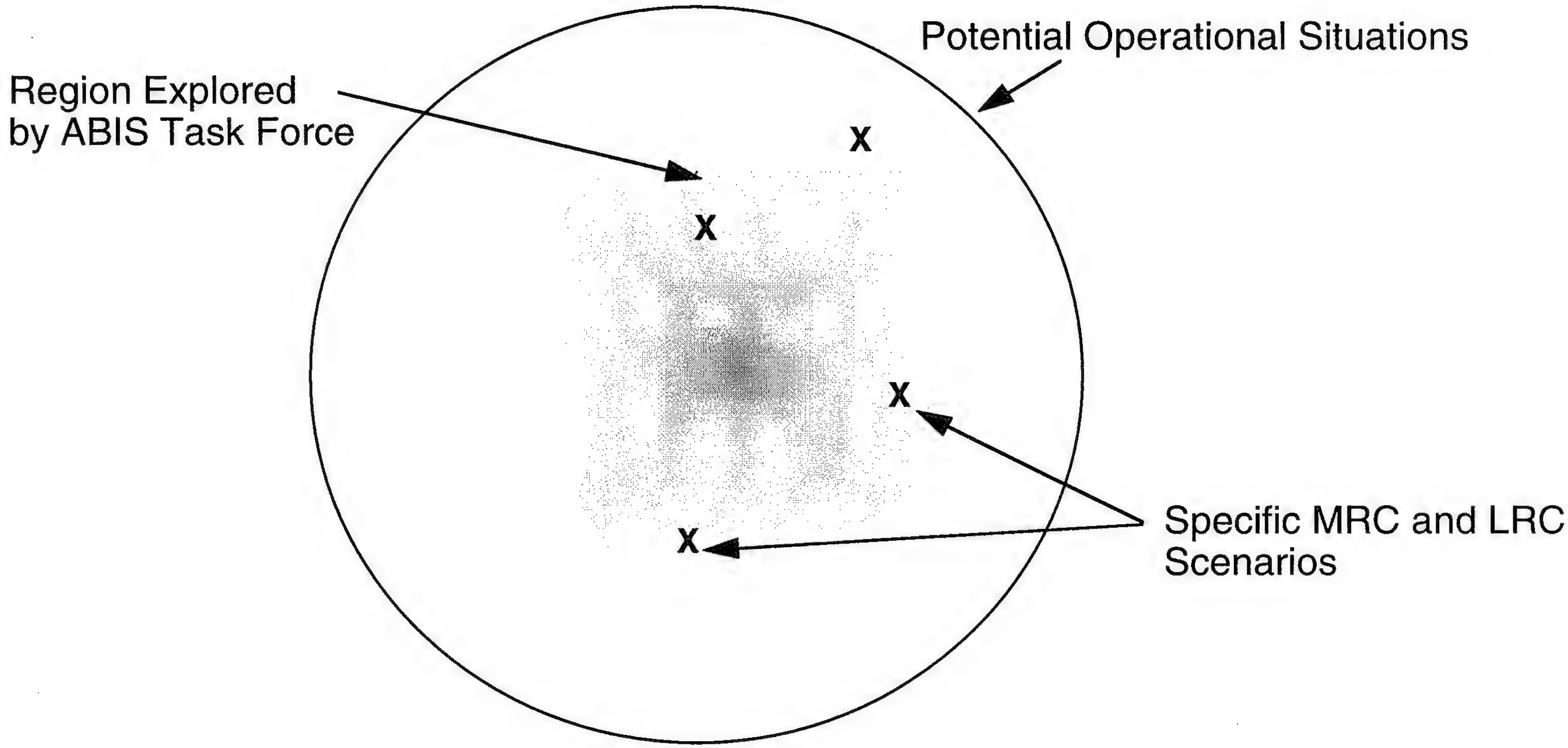
Detailed Steps in Methodology *(Continued)*

The fourth and fifth activities (IV-V), derive the implications for the DoD's science and technology program, and then create roadmaps for developing the needed technology. These activities are the subject of Annex B: Mapping of Operational Capabilities, Critical C2 Functions and Technology Initiatives, and correspond in large measure to the science and technology aspect previously mentioned.

Finally, the full implementation of ABIS is developed in the final step of activity V, and is covered in more detail in Annex D: A Process for the Evolution of ABIS. This annex addresses the evolution of the technology and operational concepts and also includes supporting actions such as the development of architectures and standards to guide the fielding of systems and technology enhancements.

An integrated view of the outputs of this methodology is presented in Volume II.

The Role of Scenarios in the ABIS Methodology



The Role of Scenarios in the ABIS Methodology

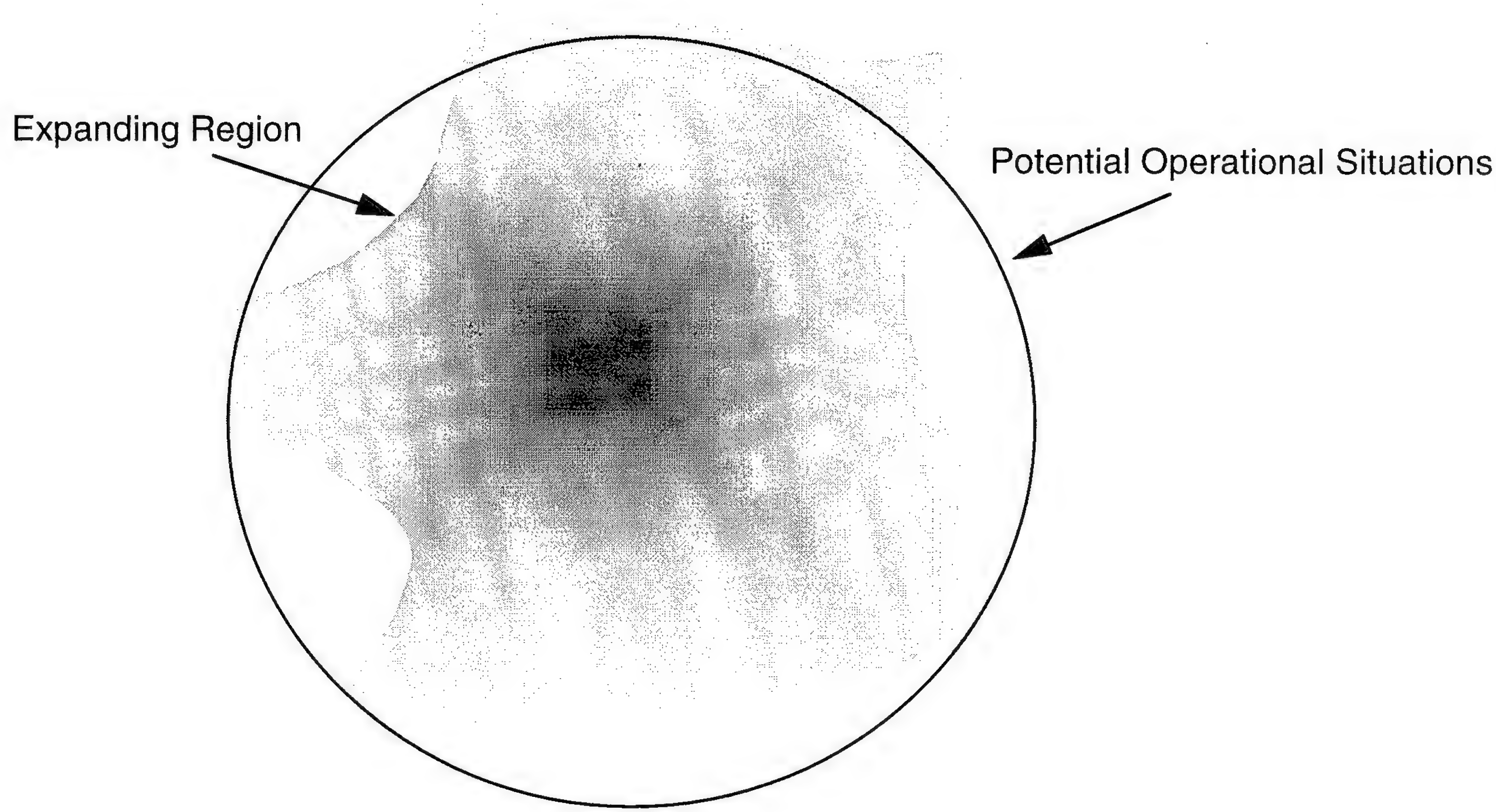
To design a capability-based force and understand the needed features of a command and control concept, it is necessary to deal with future uncertainty. The U.S. military must be capable of operating in a variety of environments, against potential adversaries equipped with a variety of capabilities, and must successfully achieve a variety of missions.

During the Cold War, the prevailing wisdom held that the most stressing combination of factors was a defensive military action in Europe against an attacking Soviet Union military force. Furthermore, it was often assumed that every other situation would be a "lesser and included case" that could be dealt with by the general-purpose force intended for European combat. In the post-Cold War era, there is no consensus on the most likely stressing situation, and it has become apparent that important aspects of some situations are not lesser and included cases of any one stressing situation. From a systems perspective, therefore, it is necessary to consider a desirable range of performance characteristics, a so-called "performance envelope," in order to design a satisfactory command and control system.

To develop an understanding of the combinations of desirable system features, varying needs and stressing conditions of different operational situations must be examined. In doing so, it is also desirable to examine a variety of scenarios that combine operational features.

The ABIS Task Force first considered general features of a major regional conflict, using likely future versions of the two MRC's currently defined in the Defense Planning Guidance, then considered aspects of lesser regional conflicts and other potential major regional conflicts that might stress future command and control concepts.

Expanding the Consideration of Operational Situations



Expanding the Consideration of Operational Situations

The ABIS study had practical limitations in scope. It considered the operational demands and the likely technical developments for important selected future situations. A capability-based force must focus on an affordable balance of desired capabilities, based on an understanding of a range of potentially likely situations wherein the force could be deployed. To be satisfactory, consideration should be given to a sufficient range of differing missions, adversaries, combat environments, force composition and capabilities, and geographic location of activity. The ABIS Task Force heuristically covered this range using expert judgment to focus. Further expansion into other operational situations (or "space") is an important part of the future of ABIS.

By operational space, we mean the multidimensional "space" of differing demands on future military forces, pictured in the figure as a notional three-dimensional space. In actuality, the dimensions of the operational space are more numerous and noncontinuous. For example, physical terrain is an important factor in conflict, as are vegetation and climate. These elements range from mountainous to level landforms, and from desert or empty tundra to triple-canopy jungle vegetation; but it is not equally likely that U.S. forces will be deployed in all of these areas. Other dimensions are equally important to actual force employment concepts and command and control concepts. Several other scenarios could be of interest to the final requirements for an ABIS-like system: a reasonably sized, dismounted force in an urban environment; a sudden contingency mission outside the normal sensor coverage areas; small units in a tropical environment; combat operations with scant a priori military intelligence, and so on. All of these dimensions influence desirable system capabilities.

The ABIS study considered the center or core of this operational space to be sustained, large-scale combined arms combat typically characteristic of a major regional contingency (MRC) with the use of precision force. This emphasis was driven by a recognition of the most likely priorities in U. S. national security decisions, determined by the likelihood, the relative importance of a situation, and the risk it entails for the United States. The task force ranked these factors as follows:

1. Maintain an evident superiority in large-scale combat, in order to provide a credible deterrent to major regional contingencies
2. In the event of such a conflict, to prevail with minimal casualties whether in a major or lesser regional contingency
3. Reasonably handle the most probable of the other combat situations
4. Handle all other activities of the military forces, from noncombat phases of operations to operations other than war, such as peacekeeping.

In terms of these priorities, the ABIS study covered many of the demands of early entry and sustained conventional combat, whether in a major or lesser regional contingency. The pre- and post-hostility phases and noncombat phases of all operations lower in the above scale of priorities were not covered. Incorporating specific features of the current Southwest Asia and Korean situations (as described in the Defense Planning Guidance) and likely future developments, a generic MRC scenario was created.

Additionally, the ABIS study was shaped by the intellectual capital derived from other studies in OSD. Consequently, the study began with the important precision strike aspects of the conflict and expanded to include full-dimension defense. Aspects of maneuver were also covered, but the full possible future interaction of maneuver with precision strike was not captured. A full command and control analysis of these elements of precision force, as well as the lower priorities noted above, should be the focus of future work.

Key Assumptions About MRC Scenarios

Environment	• Variable Terrain, Deserts in Southwest Asia to Mountains in Korea • Distance From CONUS > 10,000 km • Littoral Locations
Adversary Characteristics	• Large Combined Arms Force, With Integrated Doctrine • Some Advanced Equipment, Both Weapons and C4ISR • Personnel Experienced and Well Trained • Weapons of Mass Destruction Present, and Potential Theater Use • Moderate Information Warfare Capability
Missions	• Delay or Stop Initial Invasion • Suppress Air Defenses • Disrupt and Destroy Enemy Ground Forces • Destroy Missiles and Weapons of Mass Destruction • Degrade National C4ISR and Leadership
Emphasized Phases of Conflict	• Initial Stabilization of Situation, Halting the Attack • Sustained Operations

Key Assumptions About MRC Scenarios

The ABIS Task Force initially concentrated on two canonical MRC scenario locations: a conflict in the Persian Gulf and a conflict on the Korean peninsula. These two theaters, which have very different terrain and climates, are both far from CONUS, thus stressing many capabilities. Future capability variations were also considered, such as an adversary equiped with advanced military equipment.

Both theaters, however, have a significant infrastructure in place for friendly use, and have littoral terrain—favoring some U.S. capabilities. In Southwest Asia (SWA), the United States has access to a number of established bases and maintains some prepositioned critical supplies. In Korea, the United States maintains not only bases and supplies, but also a significant number of forward-deployed troops. Also, in both situations, there are potential allies with significant military capabilities.

In both scenarios, the general military problem and the general campaign strategy are similar. Both cases involve a hostile invasion of a friendly nation, so both require that a large, combined arms force be halted early in the campaign. This would be followed by a U.S. build-up and subsequent eviction of the aggressor. This study focused on the difficult initial stabilization of the situation and the final eviction.

Selected Important Parameters From the MRC Scenario

- Surveillance
  - Six Potential Adversaries Today, More Tomorrow
  - Nearly 50 Flashpoints, With More Than 20 Territorial Disputes in Asia Alone
- Situation Monitoring and Assessment
  - Thousands of Units/Events in 10's of Minutes
  - Damage Assessment Demanding Coordination of Timing
- Planning
  - Integrated Tasking Orders (ITO) and Updates for 100's of Fixed Targets in Hours
  - Process 10's of Targets Per Minute at Peak
- Force Management
  - Monitor More Than 1,000 Targets Per Asset, Tasking 10's of Sensors
  - Efficiently Apportioning Sensors Between Shooters and Targets
  - Direct More Than 1,000 Actions Per Hour at Peak
  - Provide Target Acquisition and Munition Control for 100's of Actions Per Hour
- Traditional Supporting Operations
  - Search and Rescue, Medical, and Logistics
  - Responses Shrinking From Days to 10's of Minutes

Selected Important Parameters From the MRC Scenario

The most stressing operational demands are listed in the accompanying figure. The first category, surveillance, differs from the others in that it spans a worldwide range of possible combat areas. This function stresses the reach and coverage of systems, and the coverage of databases, rather than the processing of new streams of data. The other categories, which are based on the Korea and SWA scenarios, serve as reasonable bounding estimates of similar conflicts elsewhere.

The scenarios provided a rich detail of operational demands, a classified description of which was provided by the Joint Staff to the working groups early in the study. The operational parameters listed in the figure were the ones that stressed the C4I system most. Many other demands were also derived, such as detecting and identifying hundreds of moving targets per hour, but these tended to be subsumed by the demands enumerated in the figure.

Important Factors in Some Other Scenarios

Environment	• Unanticipated Locales, Without Previously Existing Databases • Unexpected Allies, With Differences Ranging From Language to Military Doctrine • Urban or Other Built-Up Areas • Thick Natural Cover, as in Jungles • Nonlittoral Locations
Adversary Characteristics	• Emergence of Peer Competitor, as the Soviet Union Was • Asymmetric Strategies in General • Terrorist Tactics • Guerrilla Tactics • Significant Information Warfare Capability
Missions	• Prevent Disruption of Civil Activities of Ally • Support for U.S. Domestic Information Infrastructure Against Information Warfare • Hostage Rescue • Monitoring or Peacekeeping • Support for New Actors, Such as Nongovernmental Organizations
Emphasized Phases of Conflict	• Prehostilities • Initial Lodgment • Extended "Peacetime" Presence in Areas of Tension • Maintenance of Civil Order

Important Factors

The additional operational complications described in the figure were derived from previous research, discussions, and experienced judgment. Several scenarios were examined in the course of the ABIS study to identify possible variations in operational needs. These scenarios, developed to illuminate newly important issues in U.S. national security policy, are also useful for considering possible operational concepts for future conventional warfare.

A series of reports provided information used by the task force.* These existing scenarios illustrate a now-familiar point—that it is likely that any adversary may choose an asymmetric strategy of some sort. The particular asymmetries developed in those reports led to the identification of the important factors listed in the above figure and reflected in the earlier discussion.

One important characteristic of some of these factors is that they frequently are operational surprises. An unexpected locale, unanticipated allies, or unsuspected enemy are, to some measure, a surprise by definition. This also implies that such characteristics are unlikely to be manifested in an MRC. An MRC, by definition, involves a large, conventional military force, which cannot suddenly appear. Rather, such surprise cases are most likely to be associated with scenarios involving some limits in scale or scope. An obvious example would be a sudden mission, perhaps to rescue hostages, or as in one scenario, to neutralize a small number of nuclear weapons.

Not all such limited scenarios need involve only small forces. For example, counterguerrilla warfare might well entail many troops, depending on the area involved, as might infantry-intensive combat in cities. Many noncombat missions, from humanitarian relief to peacekeeping, can also require large forces. In some instances, there may also be a need to support other than military entities, for example, nongovernment organizations (NGO) such as the Red Cross or church relief groups.

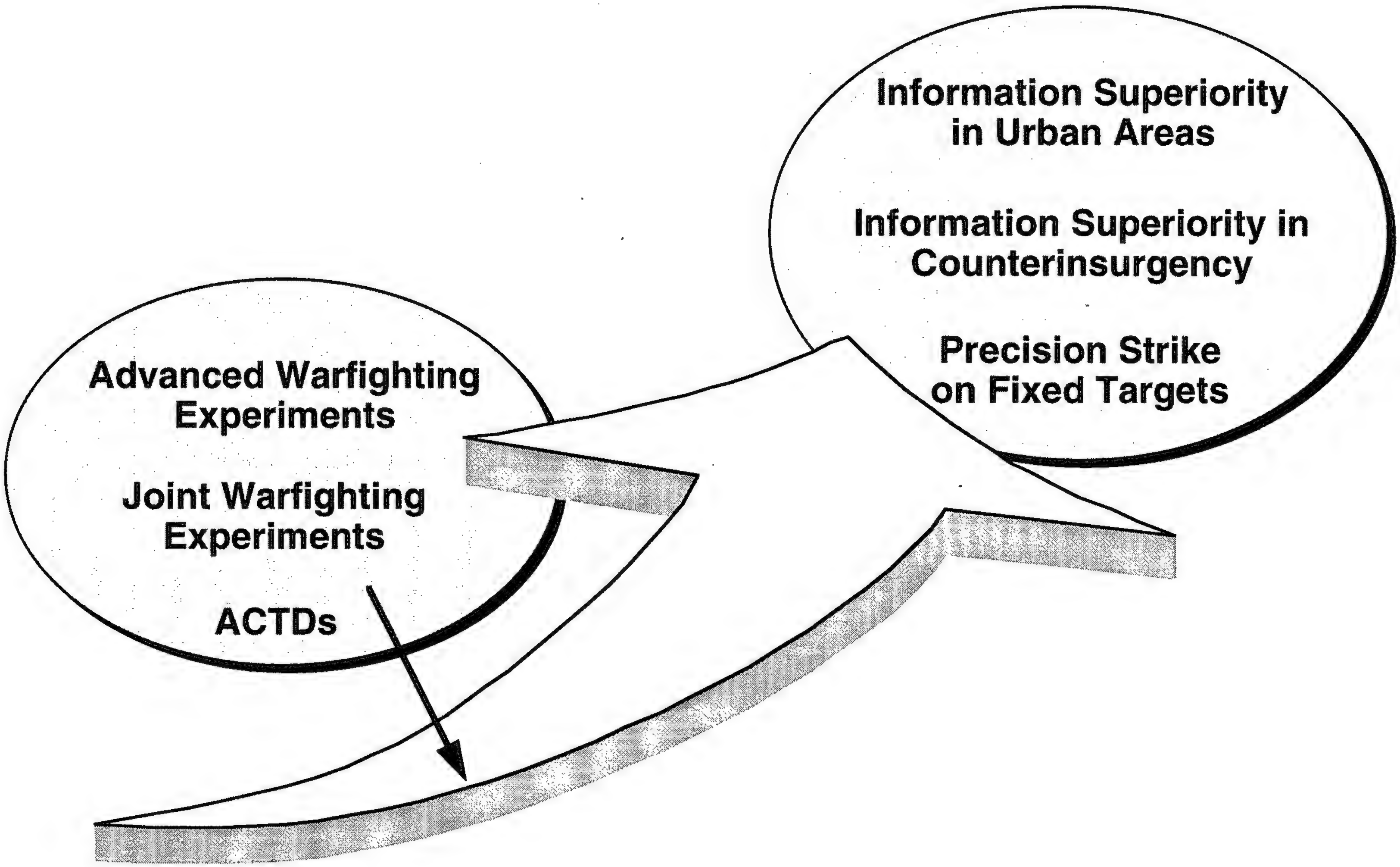
Some of the aforementioned characteristics would not involve a surprise. An emergent peer competitor might not now be apparent, but presumably would become so well before it was a full peer. Likewise, few today would be surprised by extended military presence in areas of tension.

In addition to considering a variety of potential future scenarios, the Integration Team held discussions with Marine Corps and Army personnel working on advanced operational concepts for small tactical units. The pending Marine Corps Sea Dragon exercise, which will experiment with 200 small teams in the field as the main force, supported by extensive indirect fire, was discussed in considerable detail, as were the Army's experiments and demonstrations of "digitization."

The important feature shared by all of these factors is a need for some change (large or small) in the force level operational concepts, and thus in the supporting command and control concepts, and ultimately, in any ABIS supporting such operations. A primary function for the future evolution of ABIS is to investigate such situations, both analytically and through experiments, and define new operational concepts. These then must be tested against the S&T plan to see if additional development efforts would be needed to preserve the capabilities illustrated in the ABIS construct.

*"The Day After..." Study: Nuclear Proliferation in the Post-Cold War World, Volumes I, II, and III, by Millot, Molander, and Wilson, RAND, 1993; and Strategic Information Warfare: A New Face of War, by Molander, Riddile, and Wilson, RAND 1996. Two studies considered some C4I implications of conventional warfare: Concept-Level Analytic Procedures for Loading Nonprocessing Communication Satellites with Nonantijam Signals and Concept-Level Analytic Procedures for Loading Nonprocessing Communication Satellites with Direct-Sequence Signals, both by Bedrosian and Huth, RAND.

Evolution of Operational Concepts



Evolution of Operational Concepts

Over the next few years, a continuing sequence of ACTDs and warfighting experiments will allow operational assessments of the value of information superiority in different parts of operational space. The most important experiments will very likely involve the Joint Battle Center. This new center will use operational systems as well as advanced prototypes, thus it can involve the force developer naturally early in any system development process. This should allow the warfighters to more easily fashion requirements at the operational architecture level.

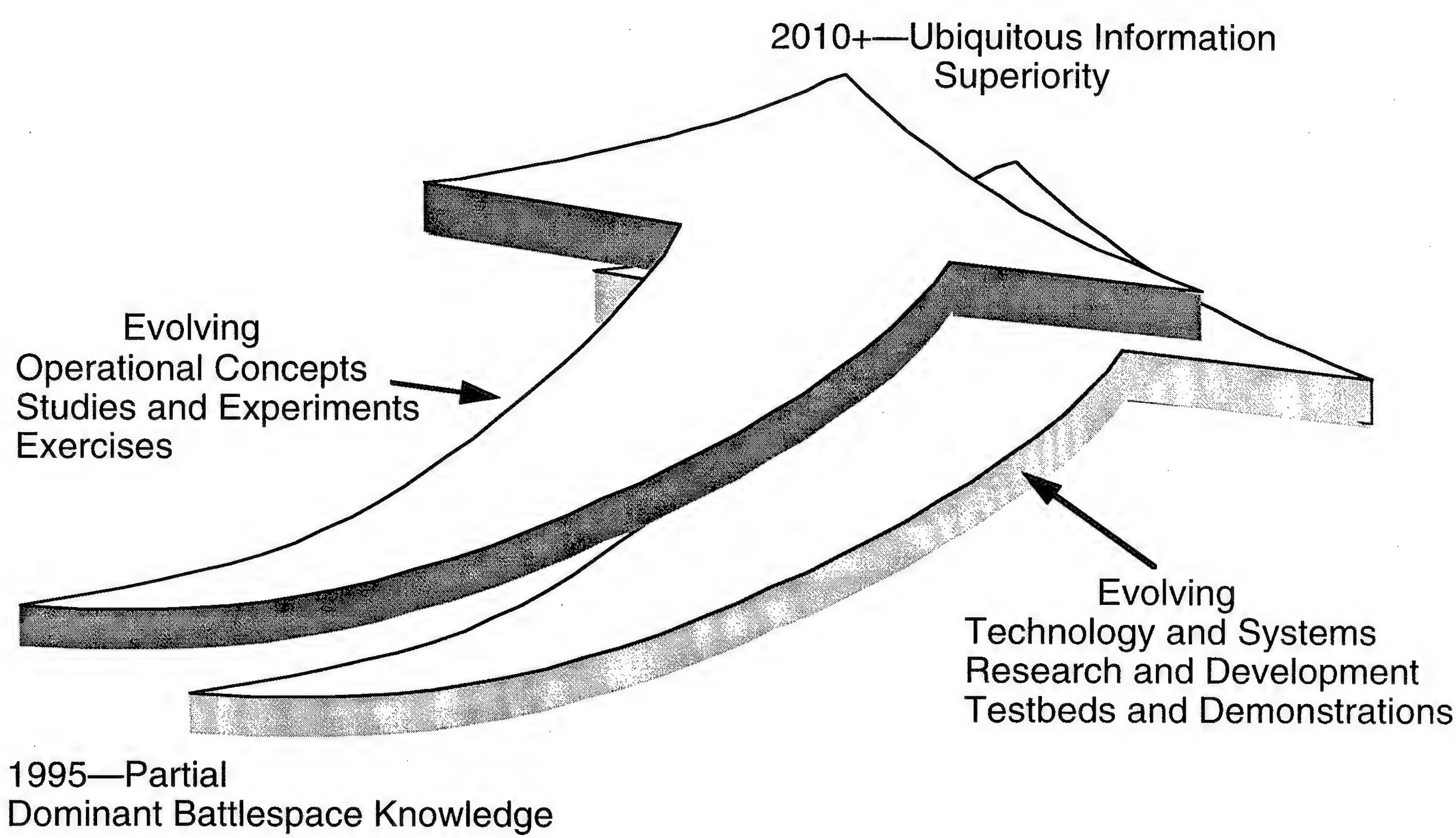
Today, the United States is largely capable of information superiority in the context of precision attacks on fixed targets. Although the timeliness and flexibility of planning such attacks are imperfect, so that we cannot easily achieve the operational tempo desired, much of the military effect of full information superiority can already be understood. Certainly, the U.S. military understands the value of such a capability, and so supports the systems needed to fully achieve it. In the broader sense though, even in the "basic" MRC case emphasized in this study, capabilities such as command by negation, empowering subordinates, and tailoring individual information environments are major changes in operational concept and practice. The warfighters need to be able to experiment with the proposed new concepts and technologies in order to understand them and adapt them to evolving operational environments.

In other combat scenarios, elsewhere in our "operational space," the benefits of information superiority will differ, as will the costs of attaining it. The operational experiments, implied by the arrow in the figure, also are important in helping the warfighters understand the role and relative importance of information superiority in other contexts, such as urban combat. As these implications become clear, the details of the ABIS construct may well need to be adjusted.

The development and use of ABIS in these other parts of the operational space involve important decisions that are not always obvious. For example, the warfighters could choose to forgo rapid data gathering in favor of a slower tempo of operations. Presumably, that slower tempo would be combined with an ability to slow the tempo of the opposing forces or other operational counters. These choices might be forced if a desired ABIS capability for some portions of operational space proves too difficult or too expensive.

Many factors will determine the range of operational space for which future military forces are actually trained and equipped. Part of the constraints will certainly be the availability of technical solutions for particular situations. A part of the purpose of the ABIS effort is to minimize that constraint: by ensuring that options for information systems available to warfighters are not "technologically constrained." Other important factors will be the perceived likelihood of a scenario, the risk to U.S. interests if the scenario were to occur, and the cost of preparing for that eventuality. Such tradeoffs are an integral part of developing and evolving a capability-based force.

Learning as We Evolve



Learning as We Evolve

The ABIS study starts an important continuing process in which the ABIS system can evolve. The study cannot fully define the future system or resolve all issues because some depend on technical and operational developments yet to come.

The figure depicts ABIS evolution as two mutually dependent arrows. One symbolizes the evolution of operational art, while the other symbolizes the continuing development of technologies and systems. These two processes must affect one another, as technical developments allow operational expansions of ABIS to more situations and more complex capabilities, and as various operational demands shift in importance, requiring adjustments in ABIS concepts, objectives, and priorities.

U.S. forces already can create isolated islands of dominant battlespace knowledge, as they did in Operation Desert Storm. Over time, the United States should expand these islands over more of the battlespace, in more different conditions of conflict, and more continuously. The ultimate vision, ubiquitous information superiority, may never be attained. ABIS should focus on making best use of available information and coping with the inevitable uncertainties, even as we strive to acquire more comprehensive knowledge.

This continuing process implies learning that is both operational and technical. This learning must be continuous, to drive the continuing developments of technology and operational art and to transmit those developments to the other "side." This implies that the continuing ABIS effort must have some of the characteristics of a *"learning"* or *"adaptive"* organization much as command and control organizations of the future should have.

Additionally, we note that this evolution cannot be merely a product of studies. Although analysis, such as that within this initial ABIS study, will play a role in guiding this evolution, a growing role must be played by operational and technical experiments. These experiments will provide experience with real alternative C4I systems, allowing the warfighters to make informed choices. Real experience with ABIS, as operational systems are fielded, will augment understanding. Together, experience and analysis will play complementary roles as ABIS evolves.

Finally, a recognition that ABIS must evolve will shape certain design features of even the earliest version of the system. The system must be designed to allow relatively rapid and continual upgrades and the insertion of more advanced technologies and subsystems. The implications of these factors for standards and architectures are addressed in Annex D, which discusses evolution.

Summary

- A Logical, Deductive Methodology Was Used That:
  - Considered the Use of Precision Force in the Two Major Regional Contingencies Currently Defined in the Defense Planning Guidance, as Well as Likely Advanced Capabilities
  - Considered Important Other Likely Variations of Future Major and Lesser Regional Contingencies
  - Considered Future Operational Concepts as Implied by Joint Vision 2010 and Other Ongoing Joint Staff and Service Efforts
  - Linked Operational Concepts, Command and Control Functional Needs, and Enabling Technology in an Interactive Process With an Explicit Audit Trail
- Using This Methodology, the ABIS Task Force Identified and Integrated:
  - Operational Capabilities for 2010
  - Needed Critical C2 Functions
  - A Broad System Construct
  - Time-Phased Operational and Technical Demonstrations, and Technology Base Programs
- Implementing the ABIS Construct Requires an Evolving, Focused, Coordinated, and Sustained Effort:
  - Operational Concepts for the Future, and Relative Priority of Functional Capabilities, Will Continue To Evolve To Meet Changing Circumstances
  - Experience With Real and Prototype Systems, and Varying Operational Concepts, in Testbeds Will Refine Analytic Conclusions Leading to a Better System Design
  - Technological Feasibility of Providing Needed Capabilities Will Continue To Change Relatively Rapidly and Somewhat Unpredictably

Summary

The ABIS Task Force has used a clear methodology and explicit logic to define a set of interrelated capabilities crucial to the future. In a broad sense, the details of the ABIS construct must evolve continually, on both an operational and technical track. The strategic framework established by this ABIS Task Force forms a construct as a starting point. As the systems realizing this ABIS capability grow and mature, operational experience and new operational needs will guide the demand for more capabilities. Those, in turn, will guide the experimentation and development of new applications of information technologies, allowing concepts, systems, and demonstrations to include other parts of the potential operational space.

Holding the ideal vision of ubiquitous information superiority as an ultimate goal helps keep these two tracks aligned. Along the way, actual information superiority in the battlespace would be attained in more and more operational situations.

Which operational situations gain the benefit of information superiority, and when they do, is an issue of priorities. After weighing the risk to United States interests, the probability of a conflict, and the cost of providing specific features of an ABIS system, future decision makers can set those priorities. This requires a broad set of participants who closely coordinate and focus on the same objectives. In addition, the systems concept must be able to accommodate situations in which we can achieve information superiority and those in which we cannot.

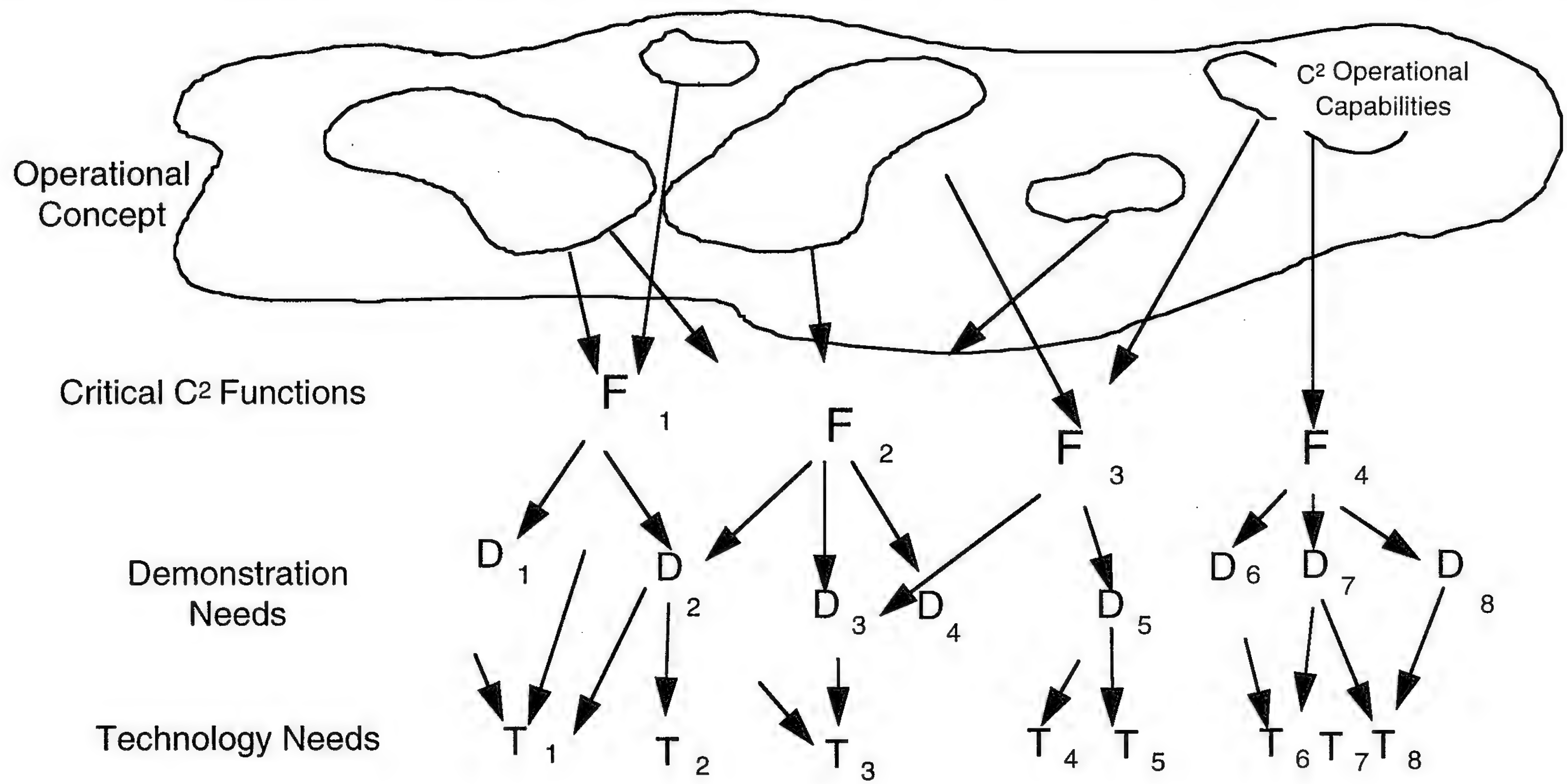
Annex B. Mapping of Operational Capabilities, Critical C2 Functions, and Technology Initiatives

Mapping of Operational Capabilities, Critical Functions, and Technology Initiatives

This annex provides the mappings from the Operational Capabilities to the Critical C2 Functional Capabilities to the Needed Technologies and provides the basis for the assessment of the current demonstration programs in support of these ABIS needs.

Mapping Operational Capabilities to Technology Developments

Key Needed Technologies and Demonstrations Have Been Identified for, and Related to, Critical Functions Associated With Important Operational Capabilities Required for the ABIS Construct.



Mapping Operational Capabilities to Technology Developments

A major objective of the ABIS effort was to establish a partnership between the appropriate operational and technical sides of DoD. The task force accomplished this through its own working relationships and by establishing an explicit audit trail that linked operational capabilities to technology.

Key elements in the audit trail are the critical functional capabilities. They are derived from an assessment of shortfalls in current C4I capabilities, and allow future operational concepts and desired capabilities to be expressed in terms that are directly related to demonstrations and the enabling technology base. They provide explicit visibility of functional areas that are needed to support new concepts, and they also provide explicit visibility of the ability or limitation of technology to provide required capability.

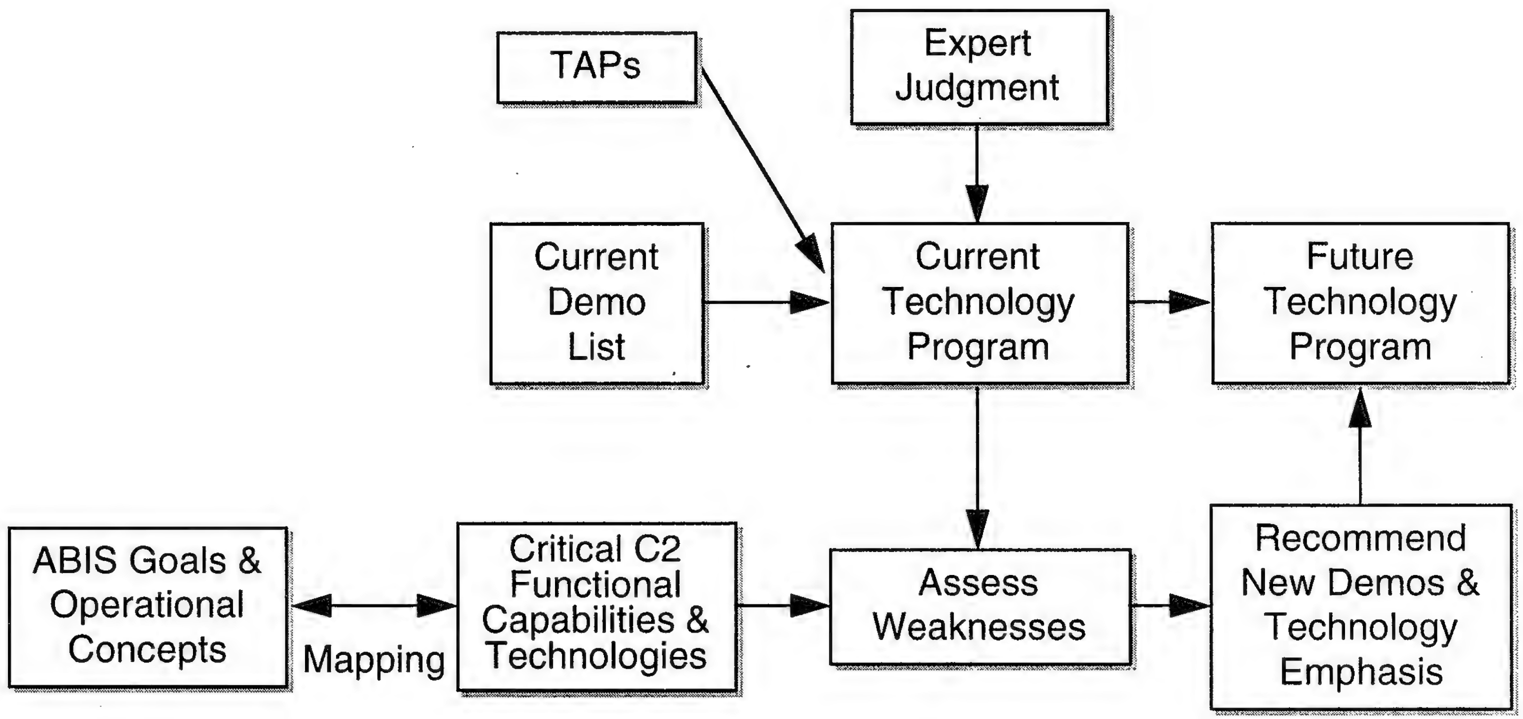
In fact (because the Task Force's work was also iterative), the mapping was also used in reverse, upward from emerging technology to prospective new operational concepts, to assess the potential contribution of technologies including those in the current S&T program. The downward trail is the normal *requirements pull* approach based on evolving operational concepts. The upward trail is the *technology push* approach that can generate significant paradigm shifts in the operational world.

The ABIS Task Force used an interactive combination of downward and upward logic trails to assure true integration of operational and technical thought rather than a linear derivation of one end of the trail from predefined inputs at the other end. The use of functional capability objectives and assessments was the central integration mechanism.

The set of technologies assessed explicitly includes commercial information technology advances to the extent known by the Task Force. The approach taken by the Task Force was predicated on the fact that the commercial market is the key driver in advancing underlying information technologies such as processors, memory, displays, communications, architectures, and languages. Nonetheless, there remains a very significant need to advance technologies to meet unique military needs, to understand and apply commercial technology to military problems, and to tailor and integrate commercial technology into military systems and information domains.

Fielding advanced military capabilities earlier than generally available in the global commercial marketplace is a crucial element in maintaining military superiority. The technology development leading to this advanced capability may or may not result in the growth of a similar commercial market, which DoD can then take advantage of. Additionally, there are sometimes technology areas in which commercial firms are unlikely to make a sustained long-term investment as desired by DoD, preferring short-term incremental improvements. This is important because the longer term investments are the most likely to lead to paradigm shifts.

Focusing the Technology Program



Goal: Provide a Basis for an Evolutionary Technology Program With the Appropriate Mix of Technology Base and Technical and Concept Demonstrations to Achieve ABIS Goals of Supporting New Warfighting Concepts by 2010.

Focusing the Technology Program

The S&T program is the foundation for achieving the ABIS vision. The current S&T program was assessed by comparing desired ABIS capabilities with the current technology program. This assessment was based on readily available documentation describing the current programs, which included the current list of ACTDs and ATDs,* a selected set of Technology Area Plans (TAP), and the expert judgment of members of the ABIS Task Force. A demonstration was considered current if it had been approved by the end of December 1995. Drawing on the available data, a roadmap was developed to summarize technology initiatives needed for ABIS.

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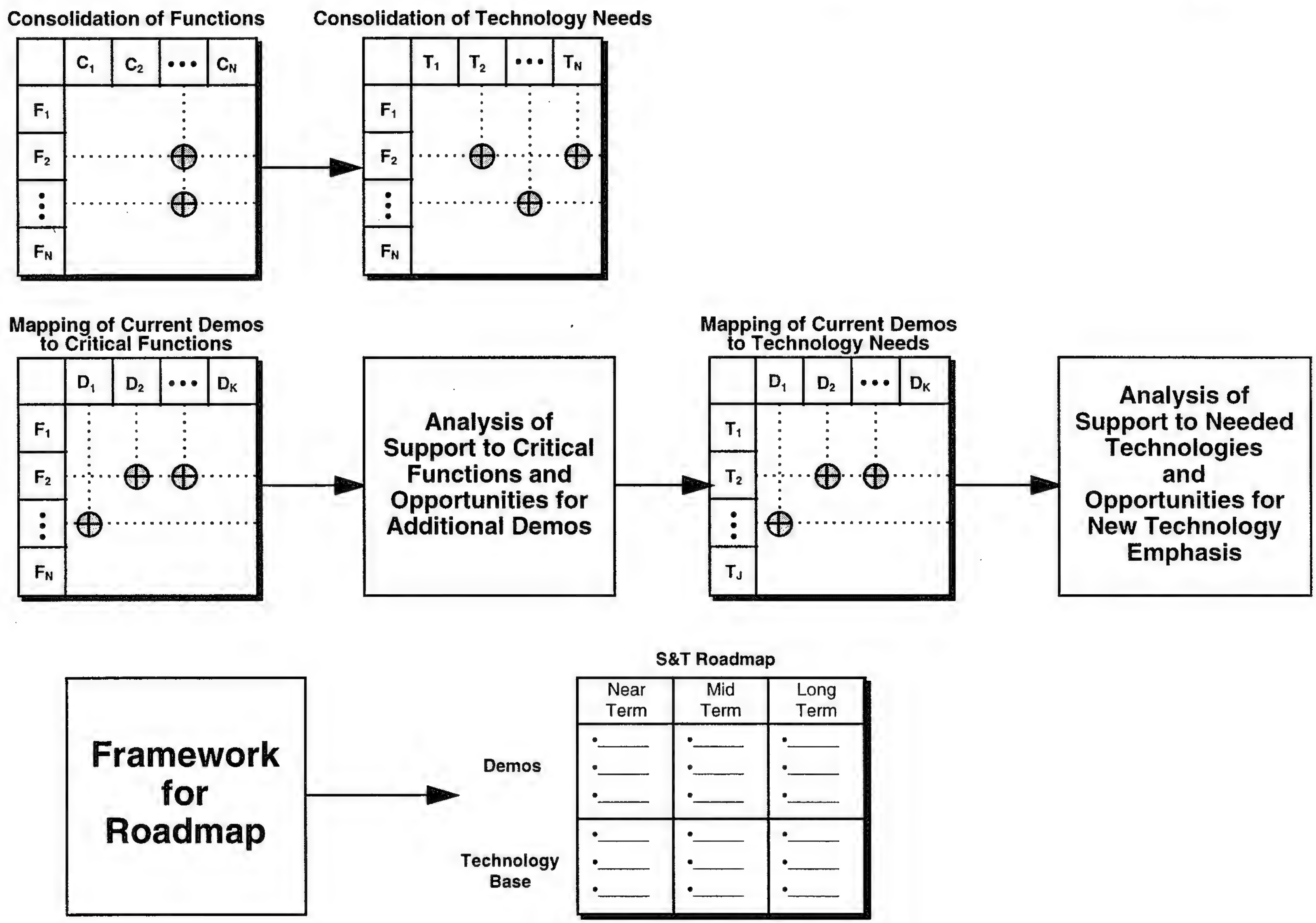
* The sources of information on these demonstrations were as follows:

1. "Description of Approved Concept Technology Demonstrations," provided to the task force by ODDR&E (this list also included 27 Army ATDs, 19 Navy ATDs, and 4 Air Force ATDs).
2 "Advanced Concept Technology Demonstration Master Plan," April 1995
3. Descriptions of 26 Air Force ATDs provided by Rome Laboratory
4. Miscellaneous material provided by task force members.

Overall Detailed Technical Assessment Methodology



Overall Detailed Technical Assessment Methodology

This methodology starts after the generation of the critical functional capabilities and needed technologies by the working groups, as shown in the detailed methodology provided in Annex A. The first step is to organize the critical functional capabilities and the needed technologies into two nonredundant lists. These are then arrayed into matrices that provide the linkages and traceability of operational capability to critical function to technology, as illustrated in the figure.

The figure depicts how matrices are used to show the support that the current demonstrations provide to critical C2 functions and needed technologies. These matrices and a review of the current Technology Area Plans (TAP) and expert judgment are used to help identify the strengths and weaknesses of the current technology program with respect to ABIS. The outcome of this action serves as input to the process of determining new demonstration opportunities and a technology roadmap, which is developed in the Needed Technology Initiatives section of Volume II.

Critical Functional Capabilities–1

1. **National Intelligence Processing for Broadcast.**[1] Correlation and fusion of National NRT SIGINT and imagery, or archived imagery for broadcast from CONUS to theater.

2. **Intelligent, Distributed MC&G**. On-line, collaborative access to full range of environmental products over 10,000's of sq. km. Thirty-meter resolution maps distributively accessed within 10's of minutes. Collaborative mapping to merge commercial imagery/maps, IMINT, RECCE in minutes.

3. **Collaborative Situation Assessment, ATR & BDA.**[1] Automatically provide processed intelligence in a common database and layered situation display tailored to user, and merge with known friendly force status data (force readiness, logistics status, etc.) as well as terrain and infrastructure data. Automatically disseminate this information on an interactive, collaborative network of operational users in the theater and CONUS. Includes tools for tailored visualization at various levels of aggregation. Objectives: Monitoring and fusion of thousands of events in tens of minutes. Situation Awareness dissemination throughout battlespace in minutes. BDA within 10's of minutes. Selected information, including mobile targets, provided to tactical units in minutes. Track status of thousands of logistics components.

4. **Common Understanding Representation Including Commander's Intent With Access & Assimilation by Warfighter**. Tailored visualization and knowledge-based presentation of situation, plan and execution status at varying levels of aggregation. Visibility of mission, centers of gravity, commander's intent, and information requirements to dynamically drive coordinated operations. Common representation of battlespace understanding. Capability for warfighters to access and assimilate all needed information rapidly and to build understanding even when gaps or ambiguities exist in the available information.

[1] Information needs to include status of friendly forces, critical enemy targets, overall BDA, and IW.

Critical Functional Capabilities

This series of eight figures gives the definitions and objectives of the 33 critical C2 functional capabilities that form the integrated list of key command and control shortfalls identified by the working groups. Subsequently in the study, these 33 critical C2 functional capabilities form the basis for the three tiered ABIS capability framework.

Critical Functional Capabilities–2

5. **Situation Projection**. Use of automated M&S and tools to project from present situation to likely alternatives into the future.

6. **IW & Spectrum Dominance Monitoring, Planning & Execution**. Planning and monitoring for IW and Spectrum Dominance. Execution of offensive and defensive oriented plans.

7. **Mission Rehearsal/Embedded Training**. Automated, distributed, embedded support to mission preview, rehearsal, and training. Objective: 100 maneuver units, 50 air/fire support units, 20 naval units.

8. **Command Projection**. Ability to incrementally deploy the theater C2I system using lightweight, deployable systems with virtual staffs via reachback and anchor desks to CONUS, while maintaining necessary capability.

9. **Support Simultaneous Engagement and Coordinated Operations**. Capability to manage simultaneous operations throughout the theater to achieve overwhelming, decisive combat power, including simultaneous engagement by a variety of warfighting systems. Includes synchronization of logistics and C4ISR systems to support these missions. Automated support to optimization of allocation and deconfliction to maximize combat power against target set. Dissemination of the Execution Plan, mission materials to the tactical units and loading of target into weapon in a timely manner. Retask force package as status of targets changes. Real-time coordination between elements of force package. Objective: 50 simultaneous coordinated missions, dissemination and retasking <1 minute.

Critical Functional Capabilities–3

10. **Dynamic Tasking Tied to Central Strategy Throughout the Joint Force.** Capability to continuously plan and dynamically task forces consistent with central strategy and commander's intent. Distributed database with dynamic updates to critical node hierarchy and strategic attack priorities. Capability for concurrent assessment of attack progress toward desired end result.

11. **Repair and Consumables Management**. Management of dynamic repair and consumables, closely collaborated with a streamlined logistics management system. Objective: 20 percent of missions require dynamic repair.

12. **Joint Force Automated Rules of Engagement**. Capability to provide automated, integrated offensive and defensive management of rules of engagement to support diversion of offensive assets to time-critical defensive tasks, or to disperse for signature reduction and survivability.

13. **Theater Intelligence Processing for Broadcast.**[1] Correlation and fusion of CONUS-based intelligence with theater intelligence, cross-sensor fusion, and subsequent processing and exploitation in NRT. Preparation of resultant fused intelligence for broadcast in theater. Objectives: fusion, processing, exploitation, and dissemination in 10's of minutes; detection and classification of high value, fleeting targets in seconds, *direct broadcast to warfighter of 2,000 target updates per hour.*

[1] Information must include status of friendly forces, critical enemy targets, overall BDA, and IW.

Critical Functional Capabilities–4

14. **Shared, Dynamic, Distributed, Continuous Collaborative Planning**. Shared dynamic plan representation linked to central strategy with distributed, collaborative plan generation and refinement. Includes automated M&S and tools to reduce time for critical nodal analysis, alternate COA evaluation and BDA analysis. Includes a look ahead, opportunity planning capability, and collaboration with a streamlined logistics planning system. Objectives: Reduce planning cycle by 50 percent, provide ATO 50 percent faster with rolling updates, and provision of some elements to be in CONUS.

15. **Rapid, Accurate Targeting.** Detect, identify, and locate *and track* critical targets and associated infrastructure. Automatically pair targets with weapons. Objective: 500 targets per hour.

16. **Rapid, Accurate Battle Damage Assessment**. Assess damage to attacked targets. Objective: *Tens of minutes,* <30 seconds *for fleeting high-value targets.*

17. **ISR and C3 System Management and Integration**. Integrated management and tasking of ISR assets, national and theater tied to central strategy. Objective: Retask ISR in <1 minute.

18. **Force Status and Execution Following**. Provision of common shared understanding of commander's intent, strategic attack priorities, force status, readiness, friendly damage, and execution status. Objective: 50 simultaneous coordinated missions.

Critical Functional Capabilities–5

19. **Parallel Dissemination of Intelligence/BDA to C2 and Shooters**. Provision to rapidly disseminate intelligence and BDA to C2 and shooters in parallel.

20. **Rapid, Accurate Target Information (Target Location and Recognition, Situation Awareness in Target Area)**. Provision for customized and streamlined automated target detection, recognition, and location and dissemination of local situation awareness to the designated shooters.

21. **Automated Mission-to-Target and Weapon-to-Target Pairing**. Rapid, automated pairing of missions to target sets and weapon to target to support the kill of high-value fleeting targets.

Critical Functional Capabilities–6

Grid Services

22. **Seamless Connectivity and Broadcast**. Connectivity to meet needs of all users with common protocols and standards. Integration across various communications media, including automatic, multilingual, multimode, adaptive interfaces. Broadcast of high rate information to warfighters at all levels of the hierarchy. Objectives: Total broadcast service to and within theater with capacity of at least 10 megabits per second. Duplex service at kilobits per second or higher. Ability to connect any user to any other user(s) within seconds.

23. **Automatic, Adaptive Information Conditioning**. Automatic compression and coding to respond to end-to-end user requirements and end-to-end link characteristics. Automatic "brokering" of quantity versus timeliness to suit needs of recipient. End user characteristics and needs automatically registered in network.

24. **Location Independent, Personal, and Group Addressing**. Addressing according to persons and organizations independent of location. Automatic routing to users on the move.

25. **Flexible, Adaptive Access Control**. Capability to manage and control access to the massive amounts of information available across the infrastructure network. Criteria are classification and need-to-know, as well as control by commanders for release of their own information outside of their commands.

Critical Functional Capabilities–7

Grid Services

26. **Support for Sessions With Heterogeneous Users and Interface Modes**. Capability to handle users in the network that operate on different communications media as well as with different types of user interfaces: voice, video, text. Ability for different types of users to establish interactive sessions with their own equipment and with noncommon interface specifications.

27. **Knowledge-Based Access, Retrieval, and Integration of Information**. Automated, smart means of knowing the user's information needs; performing efficient, smart searches for retrieval through distributed, heterogeneous databases; and presenting the information in a format to best support the user. Contextual interpretation, systemwide metadata, hyperlinks, and semantic networks. Ensuring that information from different sources is consistent by resolving ambiguities and conflicts. Objectives: focused, multidomain database search and retrieval within 3 minutes; total grid database search and retrieval within 30 minutes. Awareness of critical system changes within 1 minute; awareness of force status in NRT.

28. **Support for Distributed, Collaborative Processes and Distributed Simulation**. Communications network for collaborative, virtual teams and distributed, interactive simulations. Centralized processing and information management support for distributed, multiuser simulations. Wideband dissemination of "background" information in support of distributed simulation environments. Provide a virtual workspace for users at all levels of capability (video, voice, data).

Critical Functional Capabilities–8

Grid Services

29. **Massive, Heterogeneous Distributed Information Management**. Management of information from massive databases with different structures. Using intelligent agents to be able to exchange information between heterogeneous databases.

30. **Precision Positioning and Timing Services**. Robust, accurate position location and timing available globally for all warfighters.

31. **Service Extension**. Provision for rapid extension of service, including mobile users, into theater areas where it is not normally provided. Modular plug-and-play packaging of communications and computing to match force packages. Interoperability with Joint, coalition, and interfacing civil systems. Small forward area footprint, small lift requirement.

32. **Grid System Management**. Automated, intelligent applications for meeting current demands and planning future allocations based on users' current status and plans. Tools to advise users as to the present status and capabilities of the Grid.

33 **Defensive IW and Information Protection**. Networked surveillance and processing to detect and characterize intrusions into the Grid. Decision support and automated control systems to respond to IW events. Multilevel Security and anti-jam capability to protect against intrusions and attacks, especially nuisance attacks. Integration of grid defensive IW with grid system management as well as physical and IW combat operations.

Critical Functional Capability Support of the Operational Capabilities

Effective Employment & Battlespace Awareness

		Critical Functional Capabilities																				
		National Intelligence Processing for Broadcast	Intelligent, Distributed MC&G	Collaborative Situation Assessment, ATR & BDA	Common Understanding Representation Including Commander's Intent with Access & Assimilation by Warfighter	Situation Projection	IW & Spectrum Dominance Monitoring, Planning & Execution	Mission Rehearsal/Embedded Training	Command Projection	Support Simultaneous Engagement & Coordinated Operations	Dynamic Tasking Tied to Central Strategy Throughout the Joint Force	Repair & Consumables Management	Joint Force Automated Rules of Engagement	Theater Intelligence Processing for Broadcast	Shared, Dynamic, Distributed, Continuous Collaborative Planning	Rapid, Accurate Targeting	Rapid, Accurate Battle Damage Assessment	ISR & C3 System Management & Integration	Force Status & Execution Following	Parallel Dissemination of Intelligence/BDA to C2 & Shooters	Rapid, Accurate Target Information (Target Location & Recognition, Situation Awareness in Target Area)	Automated Mission to Target and Weapon to Target Pairing
Effective Employment	Predictive Planning & Preemption					•	•		•		•	•			•				•			•
	Integrated Force Management						•	•	•	•	•	•	•			•	•		•			
	Execution of Time Critical Missions													•	•	•	•	•	•			•
Battlespace Awareness	Consistent Battlespace Understanding	•	•	•	•	•								•					•	•	•	
	Precision Information Direction	•					•	•						•	•	•	•	•				

Grid

		Critical Functional Capabilities											
		Seamless Connectivity & Broadcast	Automatic, Adaptive Information Conditioning	Location Independent, Personal & Group Addressing	Flexible, Adaptive Access Control	Support for Sessions with Heterogeneous Users & Interface Modes	Knowledge-Based Access, Retrieval, and Integration of Information	Support for Distributed, Collaborative Processes and Distributed Simulation	Massive, Heterogeneous Distributed Information Management	Precision Positioning & Timing Services	Service Extension	Grid System Management	Defensive IW & Information Protection
Grid	Distributed Environment Support					•	•	•	•	•			
	Universal Transaction Services	•	•	•	•								
	Assurance of Services										•	•	•

Critical Functional Capability Support of the Operational Capabilities

These matrices identify the primary critical C2 functional capabilities that support each of the operational capabilities. They define the traceability from operational capability to critical C2 functional capability and vice versa. The Grid functions are shown separately because they tend to be distinct and are system oriented rather than operationally oriented. Clearly, all of the functions are needed to support the warfighter, but only direct support is shown here. General support is manifested in the hierarchy of the three operational areas; that is, the Grid supports battlespace awareness and effective employment, and battlespace awareness supports effective employment.

The grouping of the operational capabilities into three categories—Effective Employment, Battlespace Awareness, and the Grid—reflects the ABIS capability framework introduced subsequently in this annex.

Consolidated Technology Needs

1. Intelligent, Distributed, Object Oriented Maps
2. Joint, Multisensor and Information Fusion, Sensor Cross-Cueing, and Tracking Algorithms
3. Automatic Target and Infrastructure ID, Recognition, Behavior, and Change Detection and BDA
4. Automated Data Validation and Data Validity Tags
5. Intelligent Agents for C4ISR Tasking
6. Cognitive Displays, Virtual Reality, and 4D Real-Time Presentation
7. Uncertainty Management and Visualization
8. Cognitive Support and Decision Aids
9. Distributed, Collaborative, Continuous Dynamic Automated Planning/ Scheduling
10. Real-Time, Distributed Object Management
11. Automated Nodal Analysis and Weaponeering
12. Automated Target/Weapon Pairing and Update
13. Rapid M&S, Including C3I, for Situation Assessment and COA Analysis
14. Fault Tolerant M&S for Mission Preview, Rehearsal, and Training
15. Image Understanding and Pattern Recognition
16. M&S for Spectrum Dominance and IW Effectiveness Evaluation
17. Agents for Intelligent Inferencing
18. Easily Deployable, Evolvable, Scaleable, Plug and Play Architecture
19. Distributed, Collaborative, Virtual Workspaces
20. Automated IPB Processes
21. Virtual Anchor Desk
22. Rapid M&S for Sensor Coverage Analysis
23. Speech and Text Understanding
24. Automatic Recognition, Routing and Analysis of Data
25. Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization and Deconfliction
26. High Rate Broadcast
27. Low Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems
28. Automated Mediators and DBMS Tools
29. IW Surveillance and Defense Tools
30. Robust, Secure, Real-Time Geolocation and Timing
31. Automated Language and Syntax Translation
32. Automated Protocol Translation
33. Multilevel, Adaptive Infosec
34. Universal Information Transaction Mechanisms
35. Rapidly Deployable Tactical Fiber Extensions
36. Tactically Extensible High-Rate and Asymmetric Mobile Communications
37. Anticipatory Services Management Tools
38. Advanced Compression, Coding, Abstraction for Conditioning of Information
39. Self Adapting Tactical/Mobile Networking
40. Multilingual, Multimode Interface Services
41. Tools for Projecting and Visualizing Grid Capabilities in Terms of Operational Need
42. Heterogeneous, Multimedia Conferencing
43. Massive Data Storage and Management

Consolidated Technology Needs

The technology needs defined by the Sensor-to-Shooter, Battle Management, and Grid Capabilities Working Groups were consolidated into this single, nonredundant list. This list, combined with judgments of when specific technologies will support specific levels of performance, forms the basis for later recommendations of time-phased initiatives.

Technologies Needed by the Critical Functional Capabilities–1

Effective Employment & Battlespace Awareness

Technology Needs:
1. Intelligent, Distributed, Object Oriented Maps
2. Joint, Multi-Sensor & Information Fusion, Sensor Cross-Cueing, & Tracking Algorithms
3. Automatic Target & Infrastructure ID, Recognition, Behavior & Change Detection & BDA
4. Automated Data Validation & Data Validity Tags
5. Intelligent Agents for C4ISR Tasking
6. Cognitive Displays, Virtual Reality, & 4D Real-Time Presentation
7. Uncertainty Management & Visualization
8. Cognitive Support & Decision Aids
9. Distributed, Collaborative, Continuous Dynamic Automated Planning/Scheduling
10. Real Time, Distributed Object Management
11. Automated Nodal Analysis & Weaponeering
12. Automated Target/Weapon Pairing & Update
13. Rapid M&S, Including C3I, for Situation Assessment & COA Analysis
14. Fault Tolerant M&S for Mission Preview, Rehearsal & Training
15. Image Understanding and Pattern Recognition
16. M&S for Spectrum Dominance & IW Effectiveness Evaluation
17. Agents for Intelligent Inferencing
18. Easily Deployable, Evolvable, Scaleable Plug & Play Architecture
19. Distributed, Collaborative, Virtual Workspaces
20. Automated IPB Processes
21. Virtual Anchor Desk
22. Rapid M&S for Sensor Coverage Analysis
23. Speech & Text Understanding
24. Automatic Recognition, Routing & Analysis of Data
25. Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization & Deconfliction

Critical Functional Capabilities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1 National Intelligence Processing for Broadcast	•	•	•	•	•					•					•		•							•	•
2 Intelligent, Distributed MC&G	•									•															
3 Collaborative Situation Assessment, ATR & BDA	•	•	•	•		•	•	•		•	•		•		•		•		•	•			•	•	•
4 Common Understanding Representation Including Commander's Intent with Access & Assimilation by Warfighter	•					•		•		•															
5 Situation Projection						•				•			•		•		•		•						
6 IW & Spectrum Dominance Monitoring, Planning & Execution							•	•	•					•		•			•						
7 Mission Rehearsal/Embedded Training						•								•					•						
8 Command Projection									•	•								•	•		•				
9 Support Simultaneous Engagement & Coordinated Operations									•										•				•		
10 Dynamic Tasking Tied to Central Strategy Throughout the Joint Force							•	•	•												•				
11 Repair & Consumables Management							•	•													•				
12 Joint Force Automated Rules of Engagement																									
13 Theater Intelligence Processing for Broadcast		•	•	•	•												•			•				•	•
14 Shared, Dynamic, Distributed, Continuous Collaborative Planning								•	•	•			•						•		•		•		
15 Rapid, Accurate Targeting											•	•													
16 Rapid, Accurate Battle Damage Assessment		•	•																						
17 ISR & C3 System Management & Integration					•				•										•		•	•			
18 Force Status & Execution Following		•	•																		•				
19 Parallel Dissemination of Intelligence/BDA to C2 & Shooters																				•			•		
20 Rapid, Accurate Target Information (Target Location & Recognition, Situation Awareness in Target Area)		•	•	•				•				•			•					•		•	•		
21 Automated Mission to Target and Weapon to Target Pairing								•				•													

Technologies Needed by the Critical Functional Capabilities

This figure and the following one show the technologies needed to carry out each critical function. This defines the traceability from critical functional capability to technology need and vice versa.

Technologies Needed by the Critical Functional Capabilities–2

Grid

Critical Functional Capabilities	25 Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization & Deconfliction	26 High Rate Broadcast	27 Low Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems	28 Automated Mediators & DBMS Tools	29 IW Surveillance & Defense Tools	30 Robust Secure Real Time Geolocation and Timing	31 Automated Language & Syntax Translation	32 Automated Protocol Translation	33 Multilevel, Adaptive Infosec	34 Universal Information Transaction Mechanisms	35 Rapidly Deployable Tactical Fiber Extensions	36 Tactically Extensible High-Rate and Asymmetric Mobile Communications	37 Anticipatory Services Management Tools	38 Advanced Compression, Coding, Abstraction for Conditioning of Information	39 Self Adapting Tactical/Mobile Networking	40 Multi-Lingual, Multi-mode Interface Services	41 Tools for Projecting & Visualizing Grid Capabilities in Terms of Operational Need	42 Heterogeneous, Multimedia Conferencing	43 Massive Data Storage and Management
22 Seamless Connectivity & Broadcast		•					•	•	•	•	•	•			•	•			
23 Automatic, Adaptive Information Conditioning														•					
24 Location Independent, Personal & Group Addressing							•												
25 Flexible, Adaptive Access Control										•									
26 Support for Sessions with Heterogeneous Users & Interface Modes							•		•							•		•	
27 Knowledge-Based Access, Retrieval, and Integration of Information	•			•			•												•
28 Support for Distributed, Collaborative Processes and Distributed Simulation							•		•							•		•	
29 Massive, Heterogeneous Distributed Information Management				•					•							•			•
30 Precision Positioning & Timing Services						•													
31 Service Extension			•								•	•							
32 Grid System Management			•										•				•		
33 Defensive IW & Information Protection			•		•				•										

Current ACTD Support of Critical Functional Capabilities–1

Effective Employment and Battlespace Awareness

Critical Functional Capabilities		Current ACTDs: Advanced Joint Planning	Rapid Force Projection Initiative	Cruise Missile Defense	HAE UAV	MAE UAV	Precision Rapid Counter-MRL	Precision SIGINT Targeting	Synthetic Theater of War 97	Battle Field Awareness and Data Dissemination	Combat Identification	Counter Proliferation	Joint Logistics	Military Operations in Built-Up Areas	Navigation Warfare	Semi-Automated Imagery Processing
1	National Intelligence Processing for Broadcast							S		F						F
2	Intelligent, Distributed MC&G															
3	Collaborative Situation Assessment, ATR & BDA	S			S	S				S	S					
4	Common Understanding Representation Including Commander's Intent with Access & Assimilation by Warfighter									S	F					
5	Situation Projection	S														
6	IW & Spectrum Dominance Monitoring, Planning & Execution														S	
7	Mission Rehearsal/Embedded Training								F					S		
8	Command Projection	S														
9	Support Simultaneous Engagement & Coordinated Operations															
10	Dynamic Tasking Tied to Central Strategy Throughout the Joint Force															
11	Repair & Consumables Management															
12	Joint Force Automated Rules of Engagement															
13	Theater Intelligence Processing for Broadcast				S			S		F		S				F
14	Shared, Dynamic, Distributed, Continuous Collaborative Planning	F					S						S			
15	Rapid, Accurate Targeting															
16	Rapid, Accurate Battle Damage Assessment															
17	ISR & C3 System Management & Integration				S	S										
18	Force Status & Execution Following															
19	Parallel Dissemination of Intelligence/BDA to C2 & Shooters		S	S			F	S			S					
20	Rapid, Accurate Target Information (Target Location & Recognition, Situation Awareness in Target Area)		S	S			F	S			F					
21	Automated Mission to Target and Weapon to Target Pairing															

F—Fully Relevant
S—Supporting

Current ACTD and ATD Support of Critical Functional Capabilities

This figure and the following three provide an evaluation of the extent to which each of the current demonstrations is relevant to each of the critical functional capabilities. As noted previously, a demonstration was considered to be current if it had been approved by the end of December 1995. An "F" signifies that the demonstration was evaluated as fully relevant to the function and addresses the major portion of the issues associated with that function. An "S" signifies that the demonstration supported a fraction of the issues, but not the major portion. No attempt was made to address whether the demonstration would fully resolve the issues. The prime objective of this effort was to identify "holes," that is, functions for which the associated issues were not being addressed, or needed additional emphasis.

Current ACTD Support of Critical Functional Capabilities–2

Critical Functional Capabilities		Grid	Current ACTDs: Advanced Joint Planning	Rapid Force Projection Initiative	Cruise Missile Defense	HAE UAV	MAE UAV	Precision Rapid Counter-MRL	Precision SIGINT Targeting	Synthetic Theater of War 97	Battle Field Awareness and Data Dissemination	Combat Identification	Counter Proliferation	Joint Logistics	Military Operations in Built-Up Areas	Navigation Warfare	Semi-Automated Imagery Processing
	22	Seamless Connectivity & Broadcast									S						
	23	Automatic, Adaptive Information Conditioning															
	24	Location Independent, Personal & Group Addressing															
	25	Flexible, Adaptive Access Control															
	26	Support for Sessions with Heterogeneous Users & Interface Modes															
	27	Knowledge-Based Access, Retrieval, and Integration of Information									F						
	28	Support for Distributed, Collaborative Processes and Distributed Simulation	F											F			
	29	Massive, Heterogeneous Distributed Information Management															
	30	Precision Positioning & Timing Services															
	31	Service Extension															
	32	Grid System Management															
	33	Defensive IW & Information Protection															

F—Fully Relevant
S—Supporting

Current ATD Support of Critical Functional Capabilities–1

Effective Employment and Battlespace Awareness

	Critical Functional Capabilities	Current ATDs: ARPA	Army					Navy					Air Force													
		JFACC	Battlespace C2	Rapid Battlespace Visualization	Battlefield Combat Identification	Digital Battlefield Communications	Total Distribution	Voice/Data Integration	Smart Skins Array	Submarine SHF Phased Array Antenna	Helmet-Mounted Mission Rehearsal Simulation System	Littoral Warfare Real-Time Electromagnetic Interference	Distributed AOC	Operations/Intelligence Integration	JTF Network Control	Reach Back for the Warrior	Survivable ATM	USTRANSCOM Planning Tools	Hypermedia Integration	Enhanced All-Source Fusion Techniques for EW	SIGINT Correlation	Hostile Target ID	Joint Stars Cueing & Correlation	Bistatic Onboard RT Fusion Processing	Expanded Situation Awareness Insertion	Speakeasy Multiband Multimode Radio
1	National Intelligence Processing for Broadcast																			S	S					
2	Intelligent, Distributed MC&G			F																						
3	Collaborative Situation Assessment, ATR & BDA					S	S												S						S	
4	Common Understanding Representation Including Commander's Intent with Access & Assimilation by Warfighter		F	S																						
5	Situation Projection						S																			
6	IW & Spectrum Dominance Monitoring, Planning & Execution											S								S						
7	Mission Rehearsal/Embedded Training										S															
8	Command Projection															S										
9	Support Simultaneous Engagement & Coordinated Operations	S																								
10	Dynamic Tasking Tied to Central Strategy Throughout the Joint Force	S																								
11	Repair & Consumables Management																									
12	Joint Force Automated Rules of Engagement																									
13	Theater Intelligence Processing for Broadcast																			S	S	S		S		
14	Shared, Dynamic, Distributed, Continuous Collaborative Planning	F				S	S						F	S				S								
15	Rapid, Accurate Targeting																									
16	Rapid, Accurate Battle Damage Assessment																									
17	ISR & C3 System Management & Integration																									
18	Force Status & Execution Following																									
19	Parallel Dissemination of Intelligence/BDA to C2 & Shooters																					S				
20	Rapid, Accurate Target Information (Target Location & Recognition, Situation Awareness in Target Area)				F																S	S	S			
21	Automated Mission to Target and Weapon to Target Pairing																									

F—Fully Relevant
S—Supporting

Current ATD Support of Critical Functional Capabilities–2

Grid

			Current ATDs																								
			ARPA	Army					Navy					Air Force													
Critical Functional Capabilities			JFACC	Battlespace C2	Rapid Battlespace Visualization	Battlefield Combat Identification	Digital Battlefield Communications	Total Distribution	Voice/Data Integration	Smart Skins Array	Submarine SHF Phased Array Antenna	Helmet-Mounted Mission Rehearsal Simulation System	Littoral Warfare Real-Time Electromagnetic Interference	Distributed AOC	Operations/Intelligence Integration	JTF Network Control	Reach Back for the Warrior	Survivable ATM	USTRANSCOM Planning Tools	Hypermedia Integration	Enhanced All-Source Fusion Techniques for EW	SIGINT Correlation	Hostile Target ID	Joint Stars Cueing & Correlation	Bistatic Onboard RT Fusion Processing	Expanded Situation Awareness Insertion	Speakeasy Multiband Multimode Radio
	22	Seamless Connectivity & Broadcast					F		S																		F
	23	Automatic, Adaptive Information Conditioning																									
	24	Location Independent, Personal & Group Addressing																									
	25	Flexible, Adaptive Access Control																									
	26	Support for Sessions with Heterogeneous Users & Interface Modes																									
	27	Knowledge-Based Access, Retrieval, and Integration of Information																		S							
	28	Support for Distributed, Collaborative Processes and Distributed Simulation												F	S		S										
	29	Massive, Heterogeneous Distributed Information Management																									
	30	Precision Positioning & Timing Services																									
	31	Service Extension					S		S	S	S																S
	32	Grid System Management														F											
	33	Defensive IW & Information Protection																F									

F—Fully Relevant
S—Supporting

Current ACTD Support of Technology Needs–1

Effective Employment & Battlespace Awareness

	Technology Needs	Advanced Joint Planning	Rapid Force Projection Initiative	Cruise Missile Defense	HAE UAV	MAE UAV	Precision Rapid Counter-MRL	Precision SIGINT Targeting	Synthetic Theater of War 97	Battle Field Awareness and Data Dissemination	Combat Identification	Counter Proliferation	Joint Logistics	Military Operations in Built-Up Areas	Navigation Warfare	Semi-Automated Imagery Processing
1	Intelligent, Distributed, Object Oriented Maps															
2	Joint, Multi-Sensor & Information Fusion, Sensor Cross-Cueing, & Tracking Algorithms				S	S		S		S		S				
3	Automatic Target & Infrastructure ID, Recognition, Behavior & Change Detection & BDA				S		S	S								F
4	Automated Data Validation & Data Validity Tags															
5	Intelligent Agents for C4ISR Tasking															
6	Cognitive Displays, Virtual Reality, & 4D Real-Time Presentation	S					S			S			S			
7	Uncertainty Management & Visualization															
8	Cognitive Support & Decision Aids															
9	Distributed, Collaborative, Continuous Dynamic Automated Planning/Scheduling	F					S						S			
10	Real Time, Distributed Object Management	S														
11	Automated Nodal Analysis & Weaponeering															
12	Automated Target/Weapon Pairing & Update															
13	Rapid M&S, Including C3I, for Situation Assessment & COA Analysis															
14	Fault Tolerant M&S for Mission Preview, Rehearsal & Training								F					S		
15	Image Understanding and Pattern Recognition															
16	M&S for Spectrum Dominance & IW Effectiveness Evaluation															
17	Agents for Intelligent Inferencing															
18	Easily Deployable, Evolvable, Scaleable Plug & Play Architecture	S														
19	Distributed, Collaborative, Virtual Workspaces	S														
20	Automated IPB Processes															
21	Virtual Anchor Desk															
22	Rapid M&S for Sensor Coverage Analysis															

F—Fully Relevant
S—Supporting

Current ACTD and ATD Support of Technology Needs

This figure and the following three provide an evaluation of the extent to which each of the current demonstrations is relevant to addressing each technology need. An "F" signifies that the demonstration was evaluated as fully relevant to the addressal of the technology need. An "S" signifies that the demonstration addresses that technology to some extent, but not fully. This assessment was made based on formal program descriptions. No attempt was made to address whether the demonstration would actually demonstrate the needed technology. The prime objective of this effort was to identify holes, that is, functions for which the associated technologies were not being addressed by the demonstration plan.

Current ACTD Support of Technology Needs–2

Grid

Technology Needs		Current ACTDs: Advanced Joint Planning	Rapid Force Projection Initiative	Cruise Missile Defense	HAE UAV	MAE UAV	Precision Rapid Counter-MRL	Precision SIGINT Targeting	Synthetic Theater of War 97	Battle Field Awareness and Data Dissemination	Combat Identification	Counter Proliferation	Joint Logistics	Military Operations in Built-Up Areas	Navigation Warfare	Semi-Automated Imagery Processing
23	Speech & Text Understanding															
24	Automatic Recognition, Routing & Analysis of Data															
25	Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization & Deconfliction	?								S						
26	High Rate Broadcast									F						
27	Low Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems															
28	Automated Mediators & DBMS Tools															
29	IW Surveillance & Defense Tools															
30	Robust Secure Real Time Geolocation and Timing															
31	Automated Language & Syntax Translation															
32	Automated Protocol Translation															
33	Multilevel, Adaptive Infosec															
34	Universal Information Transaction Mechanisms															
35	Rapidly Deployable Tactical Fiber Extensions															
36	Tactically Extensible High-Rate and Asymmetric Mobile Communications															
37	Anticipatory Services Management Tools															
38	Advanced Compression, Coding, Abstraction for Conditioning of Information															
39	Self Adapting Tactical/Mobile Networking															
40	Multi-Lingual, Multi-mode Interface Services															
41	Tools for Projecting & Visualizing Grid Capabilities in Terms of Operational Need															
42	Heterogeneous, Multimedia Conferencing															
43	Massive Data Storage and Management															

F—Fully Relevant
S—Supporting
?—Possibly Addressing Some Aspect

Current ATD Support of Technology Needs–1

Effective Employment & Battlespace Awareness		Current ATDs																								
		ARPA	Army					Navy					Air Force													
	Technology Needs	JFACC	Battlespace C2	Rapid Battlespace Visualization	Battlefield Combat Identification	Digital Battlefield Communications	Total Distribution	Voice/Data Integration	Smart Skins Array	Submarine SHF Phased Array Antenna	Helmet-Mounted Mission Rehearsal Simulation System	Littoral Warfare Real-Time Electromagnetic Interference	Distributed AOC	Operations/Intelligence Integration	JTF Network Control	Reach Back for the Warrior	Survivable ATM	USTRANSCOM Planning Tools	Hypermedia Integration	Enhanced All-Source Fusion Techniques for EW	SIGINT Correlation	Hostile Target ID	Joint Stars Cueing & Correlation	Bistatic Onboard RT Fusion Processing	Expanded Situation Awareness Insertion	Speakeasy Multiband Multimode Radio
1	Intelligent, Distributed, Object Oriented Maps			F																						
2	Joint, Multi-Sensor & Information Fusion, Sensor Cross-Cueing, & Tracking Algorithms																			S			S	S	S	
3	Automatic Target & Infrastructure ID, Recognition, Behavior & Change Detection & BDA																								S	
4	Automated Data Validation & Data Validity Tags																									
5	Intelligent Agents for C4ISR Tasking																									
6	Cognitive Displays, Virtual Reality, & 4D Real-Time Presentation		S											S				S								
7	Uncertainty Management & Visualization																									
8	Cognitive Support & Decision Aids																									
9	Distributed, Collaborative, Continuous Dynamic Automated Planning/Scheduling	F					S						F	S				S								
10	Real Time, Distributed Object Management												S													
11	Automated Nodal Analysis & Weaponeering																									
12	Automated Target/Weapon Pairing & Update																									
13	Rapid M&S, Including C3I, for Situation Assessment & COA Analysis		S																							
14	Fault Tolerant M&S for Mission Preview, Rehearsal & Training		S								S															
15	Image Understanding and Pattern Recognition																									
16	M&S for Spectrum Dominance & IW Effectiveness Evaluation																									
17	Agents for Intelligent Inferencing																									
18	Easily Deployable, Evolvable, Scaleable Plug & Play Architecture																									
19	Distributed, Collaborative, Virtual Workspaces	S	S										S													
20	Automated IPB Processes																									
21	Virtual Anchor Desk	F																								
22	Rapid M&S for Sensor Coverage Analysis																									

F— Fully Relevant
S—Supporting

Current ATD Support of Technology Needs–2

Grid

	Technology Needs	Current ATDs: ARPA	Army					Navy					Air Force													
		JFACC	Battlespace C2	Rapid Battlespace Visualization	Battlefield Combat Identification	Digital Battlefield Communications	Total Distribution	Voice/Data Integration	Smart Skins Array	Submarine SHF Phased Array Antenna	Helmet-Mounted Mission Rehearsal Simulation System	Littoral Warfare Real-Time Electromagnetic Interference	Distributed AOC	Operations/Intelligence Integration	JTF Network Control	Reach Back for the Warrior	Survivable ATM	USTRANSCOM Planning Tools	Hypermedia Integration	Enhanced All-Source Fusion Techniques for EW	SIGINT Correlation	Hostile Target ID	Joint Stars Cueing & Correlation	Bistatic Onboard RT Fusion Processing	Expanded Situation Awareness Insertion	Speakeasy Multiband Multimode Radio
23	Speech & Text Understanding																									
24	Automatic Recognition, Routing & Analysis of Data																									
25	Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization & Deconfliction																									
26	High Rate Broadcast								S	S																
27	Low Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems																									
28	Automated Mediators & DBMS Tools																									
29	IW Surveillance & Defense Tools																									
30	Robust Secure Real Time Geolocation and Timing																									
31	Automated Language & Syntax Translation																									
32	Automated Protocol Translation																									
33	Multilevel, Adaptive Infosec																									
34	Universal Information Transaction Mechanisms																									
35	Rapidly Deployable Tactical Fiber Extensions																									
36	Tactically Extensible High-Rate and Asymmetric Mobile Communications					S		S	S	S																S
37	Anticipatory Services Management Tools																									
38	Advanced Compression, Coding, Abstraction for Conditioning of Information																									
39	Self Adapting Tactical/Mobile Networking																									
40	Multi-Lingual, Multi-mode Interface Services																									
41	Tools for Projecting & Visualizing Grid Capabilities in Terms of Operational Need																									
42	Heterogeneous, Multimedia Conferencing																									
43	Massive Data Storage and Management																									

F—Fully Relevant
S—Supporting

Evaluation of Support to Critical Functional Capabilities–1

Measured by Level of Activity in Demonstrations

Moderate to High Activity

- Rapid, Accurate Target Information (Target Location and Recognition, Situation Awareness in Target Area)
- Parallel Dissemination of Intelligence/BDA to C2 and Shooters
- Shared, Dynamic, Distributed, Continuous Collaborative Planning
- Mission Rehearsal/Embedded Training
- National Intelligence Processing for Broadcast
- Theater Intelligence Processing for Broadcast
- Collaborative Situation Assessment, ATR and BDA
- Common Understanding Representation Including Commander's Intent with Access and Assimilation by Warfighter
- Seamless Connectivity and Broadcast
- Support for Distributed, Collaborative Processes and Distributed Simulation
- Service Extension

Some Activity

- Intelligent, Distributed MC&G
- Knowledge-Based Access, Retrieval, and Integration of Information
- Grid System Management
- Defensive IW & Information Protection

Evaluation of Support to Critical Functional Capabilities and Technology Need

This figure and the following three depict the results of an evaluation of the level of activity in the current demonstration program with respect to each of the critical functional capabilities and technology needs. Roughly speaking, "Little or No Activity" was defined as either no entries or one or two "S's." "Some Activity" was defined as several "S's" or only one "F." "Moderate to High Activity" was defined as one "F" and several "S's" or two or more "F's."

In the concluding figure, Evaluation of Support to Technology Needs 2, the technologies are aggregated under a higher level descriptive category for ease of summarization.

Evaluation of Support to Critical Functional Capabilities–2

Measured by Level of Activity in Demonstrations

Little or No Activity

- Rapid, Accurate Targeting
- Rapid, Accurate Battle Damage Assessment
- Automated Mission to Target and Weapon to Target Pairing
- Support Simultaneous Engagement and Coordinated Operations
- Dynamic Tasking Tied to Central Strategy Throughout the Joint Force
- Force Status and Execution Following
- Repair and Consumables Management
- Joint Force Automated Rules of Engagement
- IW and Spectrum Dominance Monitoring, Planning, and Execution

- Command Projection
- Situation Projection
- ISR and C3 System Management and Integration
- Automatic, Adaptive Information Conditioning
- Location Independent, Personal, and Group Addressing
- Flexible, Adaptive Access Control
- Support for Sessions with Heterogeneous Users and Interface Modes
- Massive, Heterogeneous Distributed Information Management
- Precision Positioning and Timing Service

Evaluation of Support to Technology Needs–1

Measured by Level of Activity in Demonstrations

Moderate to High Activity

- Joint, Multisensor and Information Fusion, Sensor Cross-Cueing, and Tracking Algorithms
- Automatic Target and Infrastructure ID, Recognition, Behavior, and Change Detection and BDA
- Distributed, Collaborative, Continuous Dynamic Automated Planning/Scheduling
- Fault Tolerant M&S for Mission Preview, Rehearsal, and Training
- Cognitive Displays, Virtual Reality, and 4D Real-Time Presentation
- High Rate Broadcast

Some Activity

- Intelligent, Distributed, Object Oriented Maps
- Tactically Extensible High-Rate and Asymmetric Mobile Communications
- Distributed, Collaborative, Virtual Workspaces
- Virtual Anchor Desk

Evaluation of Support to Technology Needs–2

Measured by Level of Activity in Demonstrations

Little or No Activity

Intelligence Processing

- Automated Data Validation and Data Validity Tags
- Image Understanding and Pattern Recognition
- Automated IPB Processes

Automated Planning and Force Management Tools

- Automated Nodal Analysis and Weaponeering
- Automated Target/Weapon Pairing and Update

Fast Running M&S for COA/C4ISR Analysis

- Rapid M&S, Including C3I, for Situation Assessment and COA Analysis
- M&S for Spectrum Dominance and IW Effectiveness Evaluation
- Rapid M&S for Sensor Coverage Analysis

Improved Cognitive, HCI Support for Understanding

- Uncertainty Management and Visualization
- Cognitive Support and Decision Aids
- Speech and Text Understanding

Tools for the C2 and IW Defense of Grid

- IW Surveillance and Defense Tools
- Multilevel, Adaptive Infosec
- Anticipatory Services Management Tools for Projecting and Visualizing Grid Capabilities in Terms of Operational Need

Robust, Secure, Real-Time Geolocation and Timing

Improved System Capability, Architecture, and Integration

- Real-Time, Distributed Object Management
- Easily Deployable, Evolvable, Scaleable Plug and Play Architecture
- Low Cost Techniques for Appending Robust Front Ends and "Shells" to Commercially Derived Systems
- Massive Data Storage and Management

Support to Seamless Networking

- Automated Language and Syntax Translation
- Automated Protocol Translation
- Universal Information Transaction Mechanisms
- Advanced Compression, Coding, Abstraction for Conditioning of Information
- Self-Adapting Tactical/Mobile Networking
- Rapidly Deployable Tactical Fiber Extensions
- Multilingual, Multimode Interface Services
- Heterogeneous, Multimedia Conferencing

Intelligent Agent and Tool Support for Operational Functions

- Intelligent Agents for C4ISR Tasking
- Agents for Intelligent Inferencing
- Automatic Recognition, Routing, and Analysis of Data
- Intelligent Agents for Knowledge Retrieval, Filtering, Sanitization, and Deconfliction
- Automated Mediators and DBMS Tools

Technology Areas Needing Emphasis in the Technology Base

Effective Employment

- Automated Planning and Force Management Tools
- Fast Running Modeling and Simulation (M&S) for COA/C4ISR Analysis

Battlefield Awareness

- Improved Intelligence Processing*
- Improved Cognitive, Human Computer Interface (HCI) Support for Understanding
- IW Event Detection, Classification, and Tracking

Grid

- Intelligent Agent and Tools for Operational Use of Information
- Support to Seamless Networking
- Tools for the Management (C2/IW) and Defense of Grid
- Improved System Management Capability, Robust Architecture, and Integration
- Robust, Secure, Real-Time Geolocation and Timing

* Even though there is significant activity in this area, it was concluded that the state-of-the-art is not sufficient for the needs of Effective Employment.

Needed Emphasis in Technology Base

This figure summarizes technology areas for emphasis. These are important enabling technologies in the ABIS construct; but they are either not currently mature enough to be useful, or they are technologies that are not being advanced by current demonstrations. These technologies require additional effort within the technology base program so that they can evolve in time to support the recommended future demonstrations.

Current Demonstrations Relevant to ABIS–1

- **Precision Rapid Counter Multiple Rocket Launcher ACTD**
  — Develop and Demonstrate a Significantly Enhanced Capability To Neutralize a Time-Critical Target Set: Large, Long-Range Multiple Rocket Launchers (MRL) Operating From Dispersed, Hardened Shelters.
- **Precision SIGINT Targeting ACTD**
  — Develop and Demonstrate a Near Real-Time, Precision Targeting, Sensor-to-Shooter Capability Using Existing Signals Intelligence Data From National and Tactical Assets.
- **Combat Identification ACTD**
  — Provide an Integrated Set of Combat Identification Capabilities To Support Air-to-Ground and Ground-to-Ground Combat.
- **Advanced Joint Planning ACTD**
  — Integrate Emerging Communications and Planning Technologies To Achieve Improvements in Time and Accuracy of Planning for Contingency Response for USACOM and Component Staffs.
- **Joint Logistics ACTD**
  — Provide the CINCs and JTF Commanders With the Capability to Rapidly Plan and Execute More Responsive and Efficient Logistics Support to Military Operations.
- **Synthetic Theater of War (STOW) '97 ACTD**
  — Combine Virtual and Constructive Simulations and Live Exercises in an Overall Exercising Mechanism That Will Allow Forces To Train in "a Virtual State of War" Without All the Restrictions and Cost of a Totally Live Exercise.

Current Demonstrations Relevant to ABIS

This figure and the following two briefly describe each of the current demonstrations relevant to ABIS.

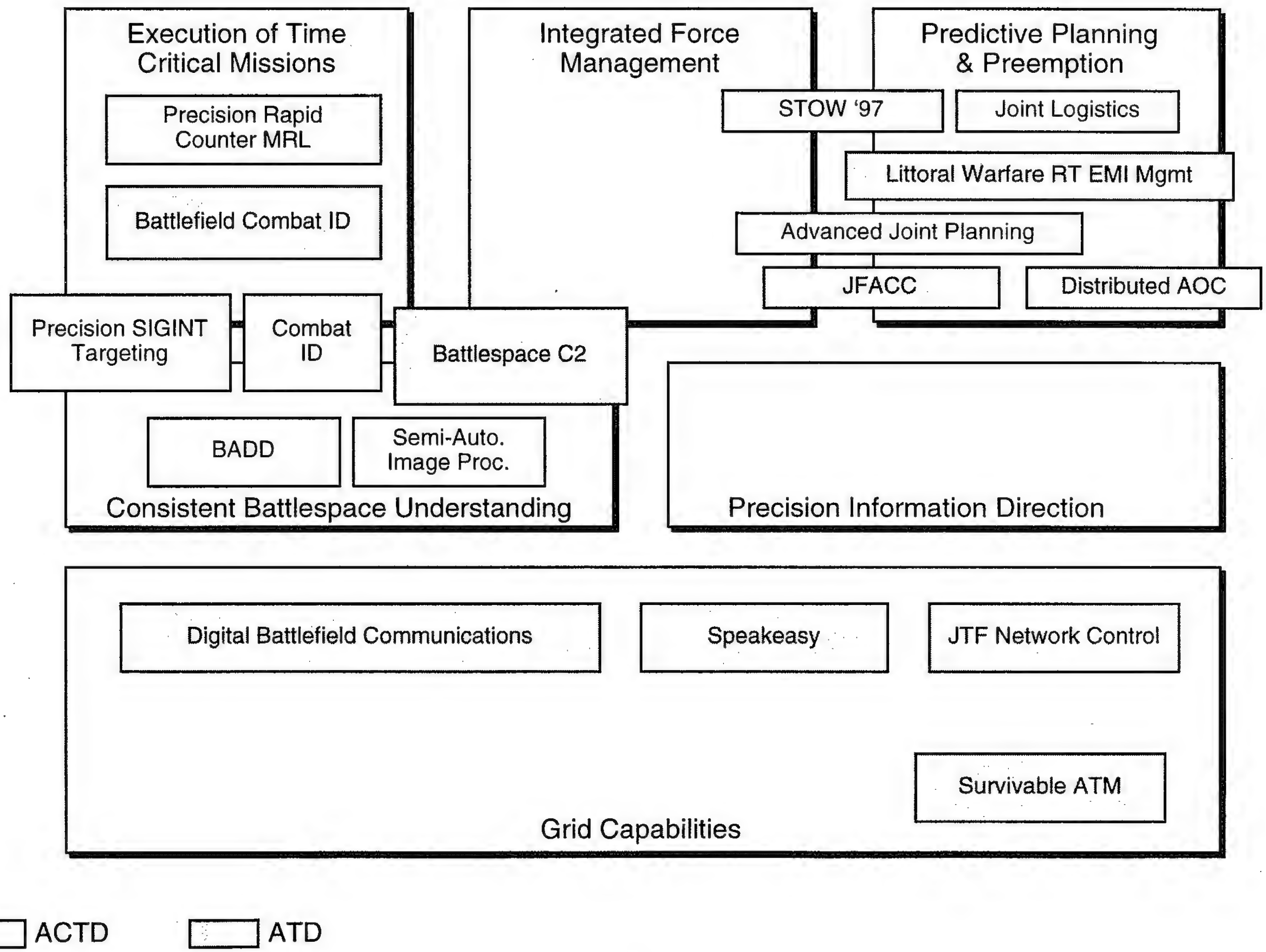
Current Demonstrations Relevant to ABIS–2

- **Distributed Air Operations Center ATD (Air Force)**
  - Demonstrate the Applicability of Distributed Computing Techniques and Object-Based Designs To Create a Geographically Deployable C3 System That Provides All of the Required C3 Functionality and Improves Its Flexibility by Permitting Multiple Locations To Operate As a Single C3 Entity.
- **Joint Forces Air Component Commander (JFACC) ATD (ARPA)**
  - Use Continuous, Concurrent, and Collaborative Planning and Automated Planning Tools To Speed Up and Integrate the Air Campaign Planning Process in Order to Hold High-Value Targets at Risk.
- **Littoral Warfare Real-Time Electromagnetic Interference Management System ATD (Navy)**
  - Demonstrate an Electromagnetic Environment Monitoring System for Real-Time Control of Combat System Frequency Assignments. Will Provide Assured Spectrum Availability for IW Without Degradation Due to Electromagnetic Interference.
- **Battlespace Command and Control ATD (Army)**
  - Develop, Integrate, and Refine Information and Knowledge Base Technologies and Systems Into a Battlefield Visualization Capability With Integrated Decision Support. Use Combat Visualization and Wargaming Support Tools To Enhance Decision/Reaction/Dissemination Timelines.
- **Semi-Automated Image Processing ACTD**
  - Rapidly Produce and Field a Capability That Will Significantly Improve an Image Analyst's Ability To Provide Accurate, Timely Situation Awareness to Warfighters.
- **Battlefield Awareness and Data Dissemination ACTD**
  - Provide a Consistent View of the Battlefield by Disseminating Operational, Intelligence, and Logistics Information Widely and Inexpensively Using Direct Digital Broadcast Satellite (DBS) Technology.

Current Demonstrations Relevant to ABIS–3

- **Digital Battlefield Communications ATD (Army)**
  - Demonstrate a Secure, Robust, Seamless, Digital, Multimedia Information Transport Capability That Is Compliant With and Exploits Emerging Commercial Standards and the DISN Architecture.
- **Speakeasy ATD (Air Force)**
  - Achieve Reliable Radio Communications Connectivities on the Battlefield by Demonstrating a Programmable Radio Supporting Multiple Bands, Wave Forms, Channels, Functions, and Platforms. It Will Have an Open, Modular Architecture With a Library of Common Modules Across Various Platforms and Radio Suites.
- **Joint Task Force Network Control ATD (Air Force)**
  - Provide the Ability To Monitor and Manage Communications Assets Across Dissimilar Network Topologies and Maintain Interoperability With the Various Protocol Stacks That Will Compose the Overall Deployed JTF.
- **Survivable Asynchronous Transfer Mode ATD (Air Force)**
  - Design, Develop, Implement Into Commercial and Government Platforms, Demonstrate, and Deliver a Set of Previously Unavailable Capabilities To Achieve and Maintain Reliable Performance of Commercial Asynchronous Transfer Mode (ATM) Technology in Military Theaters of Operations.

Relationship of Current Demonstrations to Operational Capabilities



Relationship of Current Demonstrations to Operational Capabilities

This figure summarizes the relationship of current demonstrations to the ABIS defined Operational Capabilities. It summarizes the complex results of the previous figures in broad terms with respect to support of ABIS needs.

Contribution of Current Program to Operational Capabilities

	Operational Capabilities	Contribution of Current Program	Relevant Efforts	Weaknesses of Current Program
Effective Employment	Predictive Planning & Preemption		•Advanced Joint Planning ACTD •Joint Logistics ACTD •USTRANSCOM Planning ATD •Total Distribution ATD •Distributed AOC ATD •JFACC ATD	•Planning Is Sequential, Nondistributed •No Coordinated IW Battle Management •Limited M&S for C4I & Spectrum Dominance Planning •M&S Too Slow for COA Analysis •Systems Are Nondistributed, Large Footprint, Slow To Deploy
	Integrated Force Management		•Counter Proliferation ACTD •STOW '97 ACTD •JFACC ATD	•Tasking of Force Elements Is Sequential, Not Simultaneous •Limited Common Presentation of Situation & Campaign Objectives •Inability to Apply Complex Roes
	Execution of Time Critical Missions		•Precision Rapid Counter MRL ACTD •Cruise Missile Defense ACTD •Precision SIGINT Targeting ACTD •Combat ID ACTD •SIGINT Correlation ATD •Battlefield Combat ID ATD	•Insufficient Speed & Accuracy of Target Location & Tracking •Inadequate & Slow Situation Assessment in Target Area •Information Dissemination to C2 & Shooters Is Sequential
Battlespace Awareness	Consistent Battlespace Understanding		•BADD ACTD •Combat ID ACTD •Semi-Automated Image Processing ACTD •Battlespace C2 ATD •SIGINT Correlation ATD •Rapid Battlespace Visualization ATD	•No Common Operational Picture •Search for Relevant Information Manually Intensive •Limited Ability to Monitor & Predict Enemy Cycles •Limited Capability to Project Red/Blue Situation
	Precision Information Direction		**None**	•No Capability to Optimize Efficiency in Use of C4ISR Assets •Limited Coverage of High Value Enemy Operational Cycles
Grid	Distributed Environment Support		•Joint Logistics ACTD •Distributed AOC ATD •Hypermedia Integration ATD •COMPASS	•Limited, Manually Intensive Processes for Information Retrieval Across Heterogeneous, Distributed Systems •Limited Support for Distributed Virtual Workspace Across Heterogeneous & Asymmetric Networks
	Universal Transaction Services		•Speakeasy ATD •Digital Battlefield Communications ATD	•Information Transport Tied to C2 Hierarchy, Limiting Flexibility of Connectivity •Limited Interoperability for Heterogeneous Systems •Limited Connectivity to on-the-Move Elements
	Assurance of Services		•Survivable ATM ATD •JTF Network Control ATD •Joint Communications Planning & Management System (JCPMS)	•Limited Capability of the C4I Infrastructure to Respond To Users' Changing Needs •Limited Capability to Monitor & Respond to IW Attacks •Limited Capability for Responsive Extension to & Within Theater

Contribution of Current Program to Operational Capabilities

Another summary way of visualizing the results is by the level of a fluid in a glass. For example, a quarter-full glass indicates only about a quarter of the operational capability needed is being addressed in the current program. The other two columns address what elements of the current program are supportive and the remaining weaknesses that need to be addressed.

Opportunity Areas for New Demonstrations

Key Critical Areas Needing Near-Term Emphasis	New Demonstration Opportunities
• C2 of Forces in the Early Stages of a Campaign	**Joint, Early Entry C4I for Rapid Force Projection**
• Automated Weapon-to-Target Pairing	**Automated Weapon-to-Target Pairing**
• Planning and Execution of an Information War in Concert with the Conventional War	**Information Warfare Battle Management**
• Quality and Speed of Visualization of the Combat Situation for the Warfighter	**Real-Time Cognition Aiding Displays**
• Integration of Multiple Sensor Information To Improve Target Acquisition and Tracking Performance	**Integrated Fusion and Target Tracking** **Automated Target Recognition**
• Dynamic Management of C4ISR Assets to Support the Objectives of the Warfighter	**Integrated Sensor Tasking**
• Dealing with Ambiguous and Heterogeneous Information	**Distributed Situation Assessment**
• Management of the C4I Infrastructure To Best Meet the Warfighters' Needs	**C4I for the Grid**
• Seamless Networking of Tactical Users Across Diverse Heterogeneous Systems	**Robust Tactical/Mobile Networking**
• Automated Secure Network Interfaces	**Information Security**

Opportunity Areas for New Demonstrations

The left-hand column in the figure lists the areas, derived from the weaknesses of the current program, that need near-term emphasis and lead to recommendations for new demonstration areas. These demonstration areas are listed in the right-hand column and are described in detail in the following five pages.

ABIS Recommended Demonstration Areas

1. **Joint, Early Entry C4I for Rapid Force Projection**: This will demonstrate the ability to provide rapid, just-in-time/just-enough command and control support for joint operations through the use of linked planning tools, on-the-move asymmetric communications, simulation, and intelligent triggers and alarms. The emphasis will be on developing operational plans at two levels: the high level to determine feasibility of the linked planning areas prior to initiating the deployment, and the detailed level for the increments that are being executed at the current time and in the immediate next phase. The demonstration will show the effectiveness of automated linkage of the individual planning tools and the use of rapid (simulated) projection of operational feasibility to develop a "rolling plan" that can be executed for the initial stages even while subsequent stages are under development. The demonstration will also show the ability to bring air assets to bear early in the operation by developing "broadly defined" air tasking that can be refined as the aircraft reach the objective area. The demonstration will evaluate real-time coordination between the air C2 and execution systems and the CJTF's early entry C4I systems to refine air tasking and assign specific targets "on the fly." The demonstration will test automatic triggers and alarms to help the battle management staffs track critical information and uncertainties, and manage critical linkages between planning and execution areas. Collaborative virtual workspace technology will be used to provide an in-transit virtual command post.

2. **Automated Weapon-to-Target Pairing**: This demonstration is a key cross-service and cross-mission theme demonstration of technologies needed to advance toward solving the operational limitations of the sensor-to-shooter timeline being too slow (poor detection of fleeting targets against a crowded battlespace, slow communications and information processing at C4ISR nodes, and slow fusion and dissemination process), and sensor-to-shooter command and control data passed through too many echelons (lack of delegation and command by negation). This series of demonstrations would enhance the shooter's effectiveness by giving the execution controller the tools and capabilities needed to enable time-critical, shooter-focused decisions based on a selected set of targets for execution in a joint environment. This weapon-to-target pairing leverages off the Army's Precision, Rapid Counter-MRL ATD and expands to include other services' participation, multiple sensors, and additional mission areas.

ABIS Recommended Demonstration Areas

3. **Information Warfare (IW) Battle Management**: This will demonstrate an initial prototype IW surveillance network for a selected set of computers and communications, using existing firewalls, mail guards, MLS guards, and the like as the IW surveillance nodes. It will demonstrate the ability to monitor and display near real-time IW status in the form of events, "tracks," and estimates, equivalent to an operational situation display. It will establish and demonstrate mechanisms to illustrate the ability to couple IW surveillance information into the network management systems. It will also provide technical foundations to support planning for both defensive and offensive IW actions and to integrate IW battle management C4I into the normal force management C4I system.

4. **Real-Time Cognition Aiding Displays**: This demonstration will focus on developing an integrated representation of the tactical situation for use by shooters and battle managers. The first objective is to integrate information across all services and mission areas to provide a comprehensive picture of the air, land, and naval situation in the area of interest. This will entail development of a display methodology providing the following: 1. unambiguous tagging of tracks and their registration in a common coordinate system, and 2. uniform cross-service representation of symbology denoting target types, target state vectors, source data, track histories, and other relevant information. The second objective will be the development and demonstration of display tailoring tools to simplify the overall situation display for specific mission areas and functions (e.g., SAM intercept of enemy air targets in an air defense mission) that interact strongly, like air defense and precision strike. Finally, the third objective will be to demonstrate the ability to interactively collaborate with other players in a multisite environment in assessing the tactical situation and planning courses of action, both between commanders at the same echelon of command and at different echelons. This capability will necessitate the transmission of interactive voice, video, and graphics between multiple sites.

ABIS Recommended Demonstration Areas

5. **Automated Target Recognition**: This will demonstrate automated and/or semi-automated classification of a limited set of high-value fleeting targets, target convoys, and their supporting infrastructure. Emphasis will be on correlation of moving target signatures with imagery signatures and other observables for use in multisensor correlation and cueing situations. Although a fully automated capability is desired, the state of the art in this technology area suggests that a semi-automated capability will probably be the most effective one. Therefore, the development of accuracy and timing performance characteristics will be critical to the effective use of this capability. A measurements and signature prediction phase will be required to develop the mandatory library of signatures required for this technology to be effective. The end user of this capability could be either the sensor resources or the shooter, depending on cueing requirements and performance timeliness.

6. **Integrated Fusion and Target Tracking**: This demonstration would be oriented at continuous tracking of fleeting targets across multiple target operational cycles, thereby expanding the effective battlespace and enabling strikes at vulnerable points in the cycle. Key elements of the demonstration would include correlation with prior tracks, uniform track labeling and geolocation, and track file definition and maintenance across multiple sensors and sensor types separated by several hours in time. Definitional issues include the physical location of central track files, organizational responsibility for track maintenance, and responsibilities/privileges for track updating.

ABIS Recommended Demonstration Areas

7. **Integrated Sensor Tasking**: The objective is to demonstrate integrated tasking of SIGINT and IMINT national and theater sensors to optimize collection for theater needs. The following elements should be tested:
   - Integrated tasking of airborne and national assets
   - Mission planning optimization between navigational, route changes versus sensor pointing changes
   - Mission planning addressing timing/task execution optimization (i.e., fulfilling a RECCE task now by changing routes versus fulfilling the task on successive orbits by adding high priority sensor tasks)
   - Integrated 24-hour (or longer) planning across multiple sensors and multiple routes
   - Sensor/strike integration for time-coordinated BDA.

8. **Distributed Situation Assessment**: This is an adjunct to the BADD ACTD to demonstrate capabilities for massive, distributed, heterogeneous database search and retrieval using the BADD distributed information servers as the information environment and the BADD WFA as the user's local client and database environment. It will emphasize several technologies and techniques for dealing with potentially ambiguous information and for creating integrated knowledge from diverse information domains. One goal will be to demonstrate the ability to create multihypothesis linkages between two to three separately managed information domains, focusing on managing consistency and ambiguity among multiple sources of red situation information. Another goal will be to create and demonstrate visual representations of multiple domain metadata with embedded hyperlinks that allow the users to create interactive, user-tailored "knowledge web objects." The demonstration will also test the use of speech recognition HCI for the WFA. These goals are consistent with the BADD goals but are beyond the scope of the currently approved and funded ACTD.

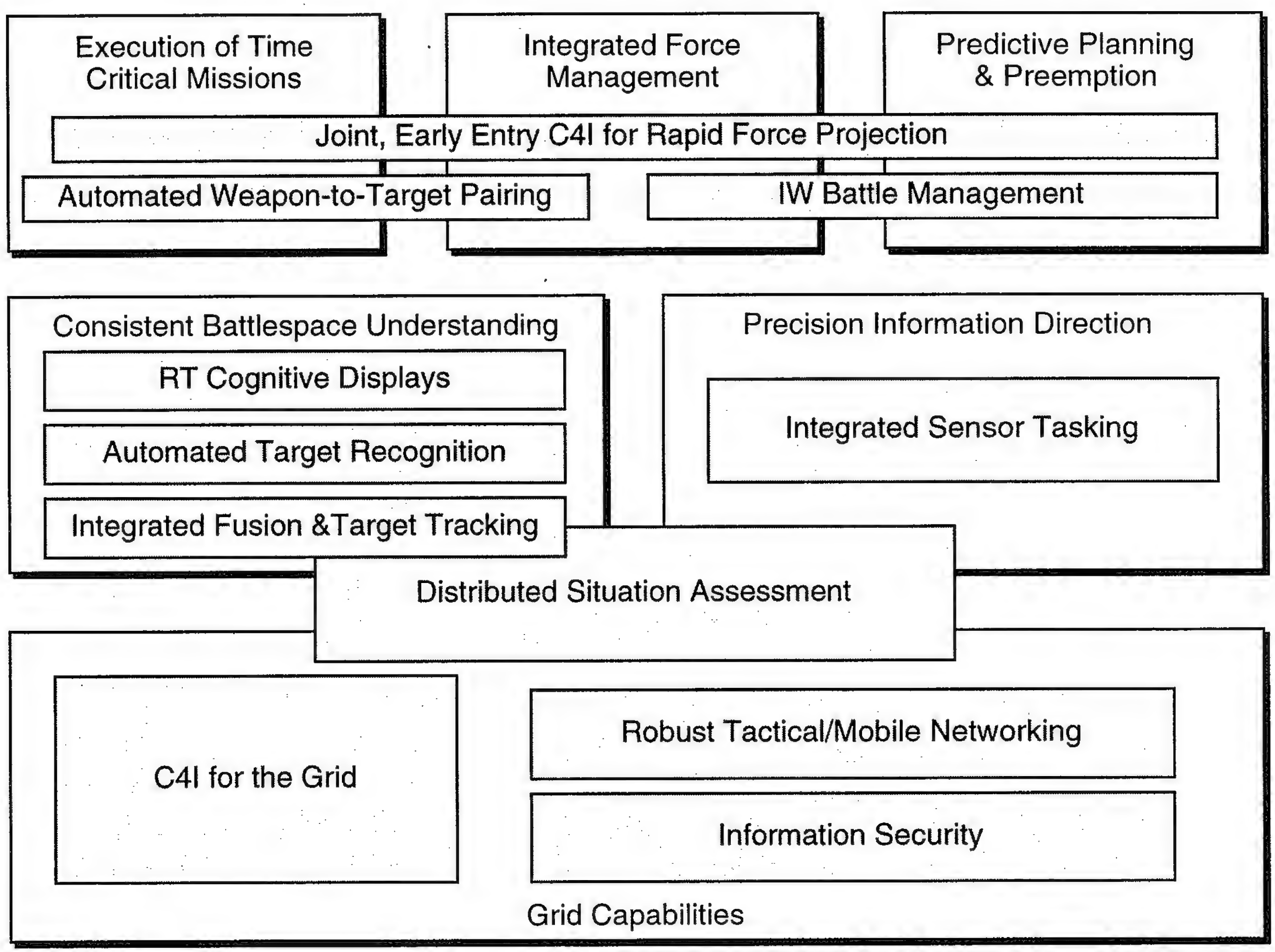
ABIS Recommended Demonstration Areas

9. **C4I for the Grid**: This will demonstrate the capability to exercise federated management of JTF and component networks using JCPMS and existing service systems, augmented by visualization aids that allow the network status to be projected onto the OPLAN and onto specific mission plans. It will also demonstrate the capability to use simulation and modeling tools to project operational plans into the network loading and analysis systems to begin to develop anticipatory network management capabilities.

10. **Robust Tactical/Mobile Networking**: This will demonstrate the capability to rapidly reconfigure tactical networks using available terrestrial, SATCOM, and relay capabilities. It will incorporate existing transport conditioning and compression, such as Radiant Tin and progressive JPEG, into the transport networks to adapt messages at selected gateways to tactical forces semi-automatically, as an initial step toward automated, adaptive conditioning. It will demonstrate capabilities to use out-of-band "orderwires" such as skypage types of circuits and other narrowband relays to input network priorities and status from the end users to the management systems. It will demonstrate the use of the BADD warfighter's associate as a potential gateway for signal conditioning and forwarding into the tactical networks, using user profiles registered in the WFA.

11. **Information Security**: This will demonstrate the use of existing guards, gateways, and multilevel workstations to provide automated interfaces among U.S. and coalition forces. Prior JWID demonstrations showed feasibility of using specific pieces of equipment to provide such interfaces, and this demonstration will build on the others to achieve a higher degree of integration across the systems, rather than the case-by-case or link-by-link capabilities that have been the focus of the prior demonstrations. The demonstration will also attempt to provide cell encryption gateways for extending ATM networking across the coalition networks, building on FASTLANE and other emerging products.

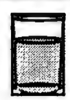
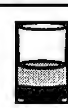
Relationship of Proposed Demonstration Areas to Operational Capabilities



Relationship of Proposed Demonstration Areas to Operational Capabilities

This figure shows the relationship of the proposed demonstration areas to the ABIS defined Operational Capabilities.

Contribution of Augmented Program to Operational Capabilities

	Operational Capabilities	Contribution of Current and Augmented Programs	How Proposed Demonstrations Contribute	Needs Beyond Augmented Program
Effective Employment	Predictive Planning & Preemption		•Joint, Early Entry C4I for Rapid Force Projection Improves Linking of Plans, Simulation, and Intelligent Triggers. •IW Battle Management Demonstrates an Initial IW Planning Capability.	•Automated Nodal Analysis •Fast Running C4I/Campaign M&S for COA and IW Planning
	Integrated Force Management		•Real Time Cognition Aiding Displays Will Improve Understanding of Commander's Intent.	•Automated Joint Force Roes •Synchronization of Forces
	Execution of Time Critical Missions		•Integrated Fusion & Target Tracking and Automated Target Recognition Support Faster and More Accurate Targeting Acquisition and Location. •Automated Weapon-to-Target Pairing Decreases the Timeline for Attacking and Killing Time Critical Targets.	•Rapid Situation Awareness in the Local Target Area •Mission to Target Pairing
Battlespace Awareness	Consistent Battlespace Understanding		•Integrated Fusion & Target Tracking and Automated Target Recognition Support Improved IPB. •Real Time Cognition Aiding Displays Support Improved Situation Awareness and Understanding	•On-Line Collaborative Access to Smart MC&G •Fused, All-Source Picture With Varying Levels of Aggregation •Situation Projection for Own and Enemy COA Estimation •Collaborative Situation and BDA Assessment •Common Representation of Battlespace Understanding
	Precision Information Direction		•Integrated Sensor Tasking Addresses Maximizing the Utility of All Available Sensor Assets to the Warfighter.	•End-to-End, Task-Synchronized, Multi-Mission Support Products to the Warfighter
Grid	Distributed Environment Support		•Distributed Situation Assessment Supports Knowledge-Based Access, Retrieval, and Integration of Heterogeneous Information.	•Distributed, Collaborative Session Support for Heterogeneous Users and Interface Modes •Virtual, Collaborative Workspace With Heterogeneous Users •Massive, Heterogeneous, Distributed Information Management
	Universal Transaction Services		•Robust Tactical/Mobile Networking Supports Rapid Configuring of Tactical Networks, Transport Conditioning, and Compression.	•More Technology Base Effort Is Needed in Location Independent Addressing and Flexible, Adaptive Access Control.
	Assurance of Services		•Robust Tactical/Mobile Networking Supports Service Extension. •C4I for the Grid Supports Federated Network Management and M&S for Anticipatory Management. •Information Security Supports Information Protection	•Automatic Integration of Information Across Systems and Networks of Varying Levels of Classification Including US and Coalition. •Control of Access to Information at Information Element, Individual User and Model-Based Aggregate Levels.

Key:

Contribution of Augmented Program to Operational Capabilities

Using the level of fluid in a glass image, this figure summarizes the improved technology and capability coverage provided by the augmented demonstration program. For each capability, the figure also addresses how coverage is improved and what is left to be done. The main reason that the technology areas in the right-hand column cannot be addressed by demonstrations in the near term is that the technology is not sufficiently mature. This information then suggests technology areas that need to be emphasized in the near-term technology base, to provide opportunity areas for demonstration in the longer term.

Areas for Future Demonstrations–1

- Distributed Empowerment
  - "Intuitive" Command Based on Shared Information Understanding in Lieu of Hierarchical Command Orders
- Intelligent, Joint Force Automated Rules of Engagement (ROE)
  - Distributed, Cooperative ROEs Intelligent Enough To Provide "Legal"-Quality Cues on Evasive and Deceptive Tracks
  - Over-the-Horizon Engagement Coordination
- Retasking and Rehearsal for Coordinated Operations Enroute and On-the-Move
  - Dissemination to Units of Enroute Coordinated Task Changes
  - Coordinated Multimission, Multiechelon Rehearsal of Coordinated Operations and Simultaneous Engagements
- Distributed Battlespace Opportunity Planning
  - Look-Ahead Precision Attrition and Counter-Move Planning Tied to a Central Strategy
- Joint Information Warfare and Spectrum Dominance
  - Dynamic Control of the Offensive and Defensive Information and Frequency Use
  - Continuous Battlespace Projection and Understanding in the Presence of Uncertainty
- Management of Dynamic Force Configurations
  - Robust Planning and Assessment by Dynamically Changing Teams on the Move

Areas for Future Demonstrations

The working groups identified a number of areas for the development of future demonstrations needed to achieve the desired future ABIS capabilities. Work must be performed to mature the technology areas listed in the previous figure before these demonstrations can be developed. These areas are listed and briefly described in this and the next figure. These demonstrations need to be further defined and carried out in the 2000 to 2005 time frame. These demonstrations and their technologies have the potential of filling the glasses from the levels shown previously in the figure entitled Contribution of Augmented Program to Operational Capabilities to completely full.

Areas for Future Demonstrations–2

- Adaptive Force Package Tailoring
  - High-Resolution Tactical Joint Force Package Tailoring
  - Reduction of Force Movement and Supply Backlog During Dynamic Reconstitution and Redeployment
- Knowledge-Based Information Presentation
  - Continuous Battlespace Projection and Understanding in the Presence of Uncertainty
- Cognitive Mission Support to the Warfighter
  - Adaptive Situation/Deception Understanding Tailored to Dynamic Course of Action (COA) and Task Assessment
- End-to-End Task Synchronized Mission Support Products to Warfighter
  - Integrated, Responsive Coordination of Tactical and Supporting Nonorganic Sensors by the Tactical Commander, With "Just-in-Time" Delivery of Processed Mission Support Products
- Distributed Access to Consistent Information
  - "Virtual Staffs" and Intelligent Agents to Tap All Available Knowledge
- Retrieval and Integration of Heterogeneous Information
  - Completely Seamless Networking, Unimpeded by Heterogeneity
- Predictive Management of the Grid
  - Anticipate and Adapt Networks and Services Using Models and Simulations to Protect Operational Needs
- Integrated Defense and Management of the Grid
  - Use of IW Surveillance and Defense Tools to Integrate Grid Management With IW C4I

Distributed Empowerment

Objective

- Provide Warfighters With Sufficient Understanding of Situation and Commander's Intent to Allow Them to Execute Missions Within the Constraints of Doctrine From Higher Authority and Actions of Adjacent and Lower Echelon Forces

Key Functional Capabilities

- Distributed, Real-Time Database Consistent With "Strategy-to-Task" Hierarchy of Predictive Battlespace Opportunity Planning
- Distributed Database Dynamic Updates to Critical Node Hierarchy and Strategic Attack Priorities
- Continuous Distributed Posting and Deconfliction of Task/Target/Time/Space/Spectrum Allocations
- Concurrent Assessment of Task Progress Toward Desired End-State
- Dynamic, Distributed Reallocation of Shared and Excess Assets (Aircraft Sorties, Surveillance, Weapons, C3 and Processing) to Most Critical Tasks and Targets in Accordance With Central Strategy
- Automated, Distributed Coordination of Supporting Tasks (e.g., Massed Fire Support) and Allocation of Multimission-Capable Assets

Technology Challenges

- Distributed Real-Time Database to Update 5,000 Task-to-Task Dependencies, Assumptions, and Temporal/Geographic/Resource Constraints, and Involving 100's of Participating Units
- Automated Aggregation to Support Execution Status, Visualization From Different Command Echelons, and Functional Viewpoints

Distributed Empowerment

This figure and the following 13 provide the goals and the needs associated with each of the 14 future demonstration areas needed to complete the ABIS capability framework.

Intelligent, Joint Force Automated Rules of Engagement

Objective

- Provide Semi-Automated Rules of Engagement to Allow Shooters To Take Immediate Action Within the Constraints of an Integrated Force Automated Battle Plan

Key Functional Capabilities

- Distributed, Cooperative Doctrine Intelligent Enough to Provide "Legal"-Quality Cues for Rules of Engagement on Evasive and Deceptive Tracks
- Automated Coordination Across Geographic and Mission Area Boundaries
- Integration of Soft Kill and Avoidance/Dispersion Options Into Automated Response Recommendations
- Over-the-Horizon Engagement Coordination (Extension of Battle Horizon and Increased Depth of Fire)

Technology Challenges

- "Intelligent" Autonomous Systems ROEs To Preclude Mistaken Engagements While Preserving Timely Responses
- Determine and Rank C2W, Deception, Signature/Spectrum Management, Dispersion Options Within 1 Minute
- Simulation of Countermeasures Effects and Signature Reduction in 2 Minutes Medium Confidence, 5 Minutes High Confidence
- Develop/Disseminate Automated Unit Tasking in Seconds Following Option Selection
- Automated Provisions for Management of Uncertainty
- Dynamic Incorporation of BDA and Intersystem Effects Into Auto-ROE Adjustment

Retasking and Rehearsal for Coordinated Operations Enroute and On-the-Move

Objective

- To Provide Near Real-Time Dissemination of Coordinated Task Changes.

  Also Provide for the Integration of Distributed, Collaborative Mission Planning, Preview and Rehearsal to Facilitate Coordinated Multimission, Multiechelon Planning and Preview.

Key Functional Capabilities

- Integration, Deconfliction, Collaborative Adjustment of Operational and Tactical Plans
- Simulated Mission Preview With Distributed, Interactive Appraisal and Modification
- Dissemination of Enroute Coordinated Task Changes in Near Real Time: Retargeting, Weaponeering, Schemes of Maneuver and Fires, Tactical Options, Etc.
- Coordinated Multimission, Multiechelon Rehearsal of Coordinated Operations and Simultaneous Engagements

Technology Challenges

- Real-Time Planning/Replanning: Objectives, Constraints, Tactics, Force Packages
- Automated Plan Linkage and Interdependency Management
- Faster Than Real-Time Operational Simulation
- Integrated Real-World and Simulated Environments for Planning and Rehearsal
- Seamless, Asymmetric Communications to Support Requirements of Users on the Move
- Low Data Rate Collaboration Across Security Boundaries Using Automated Sanitization

Distributed Battlespace Opportunity Planning

Objective

- Provide Commanders With the Capability to Foresee Possible Near-Future Strategy and Tactics Options Based on Those of the Enemy That Can Be Exploited to Advantage

Key Functional Capabilities

- Look-Ahead, Multioption Optimization to a Central Offensive and Defensive Strategy Across Time, Space, Resources, and Spectrum
- Integrated IW, C2W, Hard Kill Options Generated and Evaluated in 10's of Minutes for 10's of Critical Targets
- Stealth and Enhanced Penetration With Minimum Collateral Damage
- WMD Options Planning in <1 Hour for Hardened Facilities and Well-Defended Sites

Technology Challenges

- Rapid, Multidimensional M&S for Situation Projection and COA Analysis
- Capabilities Constrained Pattern Recognition for Opportunity Identification
- Multidimensional Optimization Given Terrain, Mobility, Resource, and Scheduling Constraints

Management of Dynamic Force Configurations

Objective

- Provide Commanders With the Capability to Robustly and Dynamically Assess and Plan Force Configurations on-the-Move

Key Functional Capabilities

- Real-Time, Continuous Access to and Between Cross-Functional Virtual Teams
- Employment of Enroute and "Within Reach" Assets
- Robust Planning and Assessment by Dynamically Changing Teams on-the-Move

Technology Challenges

- Real-Time Tailored Support to Tactical Execution by Anchor Desks in a Corps-Sized Force
- Compatibility of Collaboration With 10's of Coalition, SOF, and Civilian Teams Using Low-Rate Networks
- Ability to Conduct End-to-End Simulation-Based Training of Logistics Perturbations Using Tactical C2 Planning Systems
- Automatic Deconfliction of Logistics to Enable Planner to Concentrate on "Ends" and Not "Means"

Joint Information Warfare and Spectrum Dominance

Objective

- Provide an Integration of Information Warfare and C3 to Deconflict Plans and Actions and to Address Common Objectives Through an Integrated Set of Actions in the Information and Frequency Space.

Key Functional Capabilities

- Monitoring of Information Warfare and Frequency Spectrum Activities
- Coordination of IW and Spectrum Use Plans
- Assessment IW, C2W, and Hard Kill Alternatives As an Integrated Set of Options
- Predictive Planning and Control of IW/C2W Options and Actions

Technology Challenges

- Analytic Basis: Models for Effects of Shared Use of Spectrum, Algorithms for Deconfliction
- Automated Tools for Planning Integrated Operations Involving IW, C2W, and Physical Actions
- Distributed, High Fidelity Simulation of Effects Versus "Cost" of IW and C2W Options
- Techniques for Measurement of C2W Effects

Adaptive Force Package Tailoring

Objective

- Provide Commanders With the Capability to Dynamically Construct and Implement Force Packages in Response to Rapidly Changing Situations

Key Functional Capabilities

- High Resolution Tactical Joint Force Package Tailoring
- Reduction of Force Movement and Supply Backlog During Dynamic Reconstitution and Redeployment

Technology Challenges

- Improve Efficiency and Responsiveness of Anchor Desks to Provide Tactical and Strategic Support
- High Performance Knowledge Bases—Near Real-Time Visibility of Assets and Forces at High Resolution While Maintaining Ability to “Reason” on Mission Capability of Packages
- Distributed, Variable Fidelity Simulation to Enable Force Mission and Support Tailoring at Varying Levels of Aggregation
- Distributed, Intelligent Agents to Translate “Means”-Based Planning to “Ends”-Based Planning

Knowledge-Based Information Presentation

Objective

- Provide the Capability to Produce and Visualize Current and Projected Battlespace Information by Providing Real-Time Collaborative Construction of Physical and Multidimensional Views of the Battlespace and Projected COAs Using MC&G Tools and Visualization Techniques That Can Adapt the View to the Warfighter's Needs

Key Functional Capabilities

- On-Line, Collaborative Access and Reasoning With MC&G and Environmental Models
- Fused, All-Source Picture Tailored to Required Level of Aggregation and Classification
- Fused Friendly Picture That Reflects Status, Planned, Events, Capabilities, Uncertainty
- Situation Projection for Own and Enemy COA Estimation

Technology Challenges

- Automated Translators and Mediators: Language, Syntax, Semantics
- Context-Based Information Filtering
- Multimedia, Context-Based and Semantic-Based Information Integration
- Automated Correlation, Fusion, and Multidomain Consistency Management
- Cognitive Support Tools: Displays, HCI, Intelligent (Context Based) Drill-Down
- Intelligent Agents for Knowledge Search, Retrieval, and Integration
- Terrain Reasoning Integrated With Model-Based Mission Reasoning

Cognitive Mission Support to the Warfighter

Objective

- Cope With Both the Massive Information and the Uncertainty of the Battlespace by Providing Intelligent Automation to Help Find, Integrate, and Present Information to Match the Context of the Task and the Warfighter's Cognitive Process

Key Functional Capabilities

- Common Representation for Battlespace Understanding in the Context of the Commander's Intent and Mission Tasking
- Mission-Tailored Visualization and Knowledge-Based Presentation of Situation, Plan, and Execution Status at Varying Levels of Aggregation in Accordance With the Commander's Intent/Tasking
- Collaboration on and Dissemination of “Understanding” to All Warfighters

Technology Challenges

- Adaptive Decision Aids to Match Decision Makers' Cognitive Processes
- Intelligent Agents for Knowledge Search, Retrieval, and Integration
- Cognitive Support Tools: Displays, HCI, Intelligent (Context Based) Drill-Down
- Context and Semantic-Based Based Information Filtering and Integration in Accordance With Cognitive Processes
- Automated Translators and Mediators: Language, Syntax, Semantics
- Multidomain Consistency Management

End-to-End Task Synchronized Mission Support Products to the Warfighter

Objective

- Provide Warfighters Responsive and Optimal C4ISR Support and C4ISR Products for Timely Support of Their Missions

Key Functional Capabilities

- Near Real-Time Tactical Awareness of Multimission Target Priorities and Strategy (or Center of Gravity) to-Task-to-Target Relationship
- Near Real-Time Visibility of ISR Coverage and Tasking at Tactical Level
- Collaborative Capability to Establish and Monitor Status of Dynamic Mission-Support Information Requirements From the Warfighter to the Information Provider
- Automated Generation of Mission Support Products Such As Target Materials

Technology Challenges

- High Speed Access and Communications Among Heterogeneous Databases
- Distributed, Collaborative, Multidiscipline, Multiechelon Collection Management and Mission Planning Environment
- Automated Target Recognition to Locate/ID, 1,000's of Targets Per Hour
- Automated Target Assessment/Targeteering to 1,000 Targets Per Hour
- Automated Weaponeering of 100's of Targets Per Hour
- Automated BDA/Combat Assessment of 100's of Targets Per Hour

Distributed Access to Consistent Information

Objective

- Provide the Capability to Operate in a Distributed, Heterogeneous Information Environment, and to Access Consistent Information and Services From Throughout the Grid With Natural, User-Friendly HCI Tailored to Suit the Operations, Including Ability to Manage Ambiguities and Uncertainties.

Key Functional Capabilities

- Knowledge-Based Access and Integration of Distributed, Heterogeneous Information
- Massive, Heterogeneous, Distributed Information Management
- Precision Positioning, Timing, and Identification Services
- Multihypothesis Tracking and Resolution

Technology Challenges

- Knowledge-Based Information Retrieval, Filtering, Integration, Deconfliction
- Translators and Mediators: Language, Syntax, Semantic
- Massive Data Storage and Management
- Robust, Secure Geolocation, Timing and Precision Mapping/Mensuration
- Flexible, Adaptive, Model-Based Information Security and Access Control

Retrieval and Integration of Heterogeneous Information

Objective

- Provide a Universal Capability to Establish Logical Connectivity and Information Exchange in Near Real Time (Seconds) for Transactions From Fixed Infrastructure Through Tactical/Mobile Users, Independent of Form, Content or Interface

Key Functional Capabilities

- Seamless Connectivity, Including Users on the Move
- Universal Transaction Packages Compatible With All Interface Modes
- Adaptive Conditioning of Information to Fit Operational Needs and Constraints, With “Brokering” at Network Nodes and Gateways for Best Choice of Quality Versus Timeliness
- Location-Independent, Personal and Group Addressing
- Flexible, Adaptive Access Control

Technology Challenges

- Universal Transaction Mechanisms
- Automated Language, Syntax, Protocol Translation
- Self-Adapting Tactical/Mobile Networking
- Tactically Extensible, High Rate, and Asymmetric Mobile Communications
- Automated Compression, Coding, Abstracting for Conditioning of Information
- Advanced, Adaptive Multilevel Security Devices

Predictive Management of the Grid

Objective

- Provide Reasonable Expectation That Services and Information Will Be Available Whenever and Wherever Needed, With Reliability and Robustness at Least Equal to Those of the Other Systems on Which the Warfighters Depend.

Key Functional Capabilities

- Service Extension: Modular Plug-and-Play for Modularity Commensurate With Force Packages, Projectability, and Scalability of Services
- Effective Management of Information and Services: Predictive to Anticipate Needs, Reactive to Respond to Changing Demands and Constraints, Robust to Defend Against Physical and IW Threats, Restorable in Accordance With Operational Priorities

Technology Challenges

- Robust Architecture
- Anticipatory (Predictive) Network Management, Linked to Operational Planning
- Rapid Responsive Management for Distributed, Federated Networks

Integrated Defense and Management of the Grid

Objective

- Achieve High Confidence in Grid Management Including Dynamic Tactical Extensions
- Provide an Integrated Ability To Conduct IW Surveillance, Predict Grid Performance, Defend Against IW, and Manage the Grid Dynamically

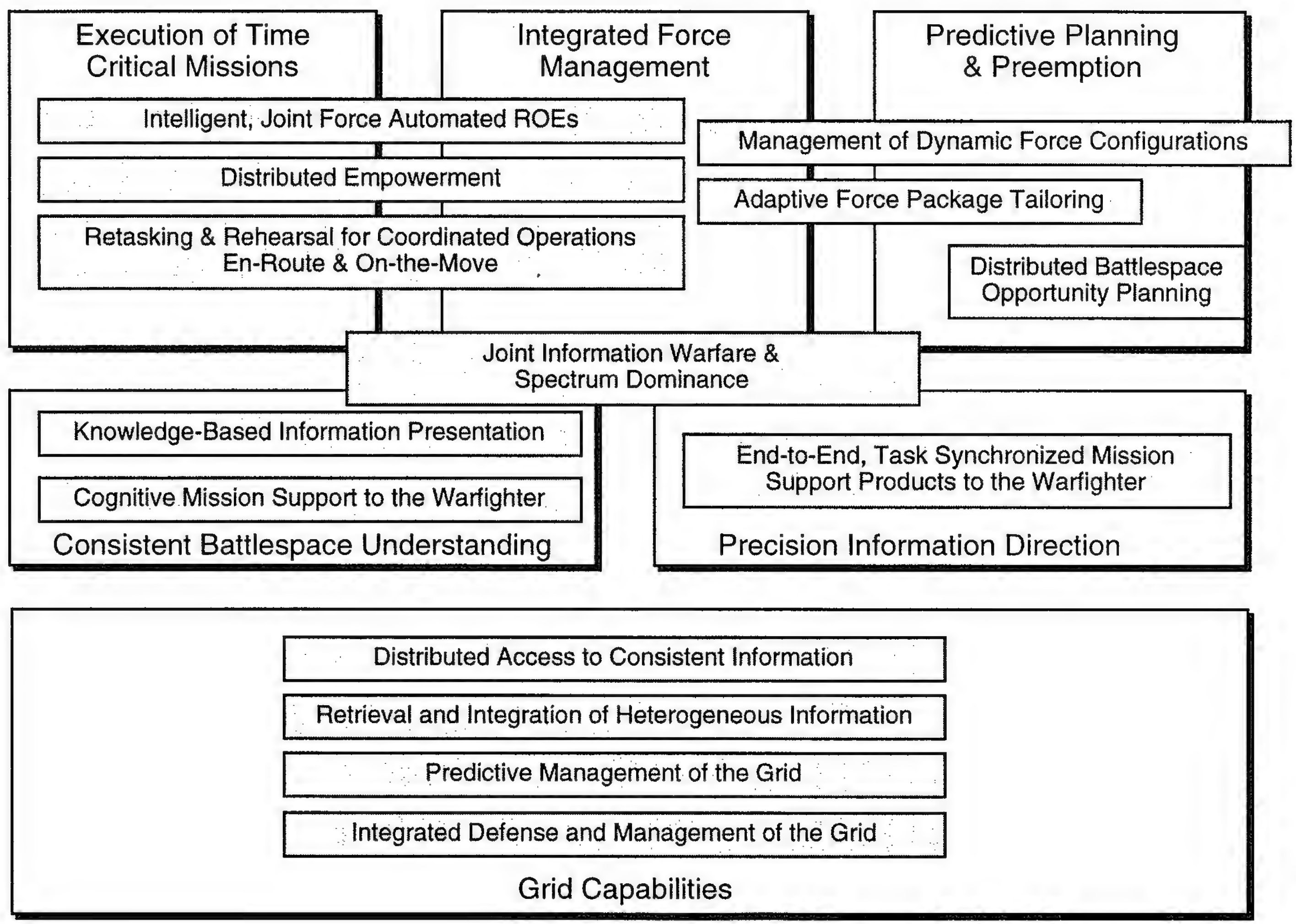
Key Functional Capabilities

- Automated Tools To Assist in Detecting and Responding to IW Threats
- Models That Aid in Anticipating Effects of IW Attacks on Grid Performance
- Adjudication of Relative Effectiveness of Alternative Counters to Anticipated and Actual IW Attacks Against the Grid
- Deconfliction of Offensive IW and Counter-C3 Actions With Grid Defensive IW Actions and Allocation of Resources, Such As Radio Spectrum

Technology Challenges

- Automated Reasoning Algorithms Appropriate to Those Domains
- Faster Than Real-Time Simulation of Actions and Potential Grid Performance
- Real-Time, Interactive Conferencing of Distributed IW, Grid Management, and Battle Managers

Relationship of Future Demonstration Areas to Operational Capabilities



Relationship of Future Demonstration Areas to Operational Capabilities

This figure depicts the relationship of the future demonstration areas to the ABIS defined operational capabilities.

ABIS Technology Roadmap

To Lay the Foundation for ABIS, a Sustained, Concerted Effort Is Needed To Focus Research and Operational Demonstrations in Critical Areas

Fully Supporting Demonstrations

Current

- **Effective Force Employment**
  - Precision Rapid Counter Multiple Rocket Launchers
  - Battlefield Combat ID
  - Synthetic Theater Of War 97
  - Advanced Joint Planning
  - C2 Joint Force Air Component Commander
  - Distributed Air Operations Center
  - Littoral Warfare RT EMI Management
  - Joint Logistics
- **Battlespace Awareness**
  - Precision SIGINT Targeting
  - Combat ID
  - Battlespace Command and Control
  - Battlefield Awareness and Data Dissemination
  - Semi-Automated Image Processing
- **Grid Services**
  - Digital Battlefield Communications
  - Multi-Band, Multi-Mode Radio
  - JTF Network Control
  - Survivable ATM

Near Term (1997–2000)

- **Effective Force Employment**
  - Integrated Fusion and Target Tracking
  - Automated Weapon-to-Target Pairing
  - Automated Target Recognition
  - Joint, Early Entry C4I for Rapid Force Projection
  - IW Battle Management
- **Battlespace Awareness**
  - Integrated Sensor Tasking
  - Real-Time Cognition Aiding Displays
  - Distributed Situation Assessment
- **Grid Services**
  - Robust Tactical/Mobile Networking
  - C4I for the Grid
  - Information Security

Long Term (2000–2010+)

- **Effective Force Employment**
  - Distributed Empowerment
  - Intelligent, Joint Force Automated Rules Of Engagement
  - Retasking and Rehearsal for Coordinated Operations Enroute and On-the-Move
  - Distributed Battlespace Opportunity Planning
  - Joint Information Warfare and Spectrum Dominance
  - Management of Dynamic Force Configurations
  - Adaptive Force Package Tailoring
- **Battlespace Awareness**
  - Knowledge-Based Information Presentation
  - Cognitive Mission Support to Warfighter
  - End-to-End Task Synchronized Mission Support Products to Warfighter
- **Grid Services**
  - Distributed Access to Consistent Information
  - Retrieval and Integration of Heterogeneous Information
  - Predictive Management of the Grid
  - Integrated Defense and Management of the Grid

Technology Base Areas

- **Effective Force Employment**
  - Automated Planning and Reasoning Tools
  - Fast Running Modeling &Simulation
- **Battlespace Awareness**
  - Improved Intelligence Processing and Fusion
  - Improved Human Computer Interface and Cognitive Support
  - IW Event Detection, Classification, and Tracking
- **Grid Services**
  - Intelligent Agent and Tool Support for Operational Functions
  - Support to Seamless Networking
  - Tools for the Management and Defense of Grid
  - Improved System Capability, Architecture and Integration
  - Robust, Secure, Real-Time Geolocation and Timing

Force Employment | **C2 Concept** | **System Concept** | **Technology** | **Implementation**

ABIS Technology Roadmap

Specific advantages in information products, system applications and capabilities, and assimilation and use of information technologies by warfighters are likely to be ephemeral. The information revolution is based on rapidly improving technology and is global with relatively easy access by everyone to technological advances. Furthermore, significant narrowly focused advanced capabilities can be gained by otherwise relatively unsophisticated adversaries. Therefore, a sustained focused research and technology application effort is necessary to maintain a superior military capability based on information technology.

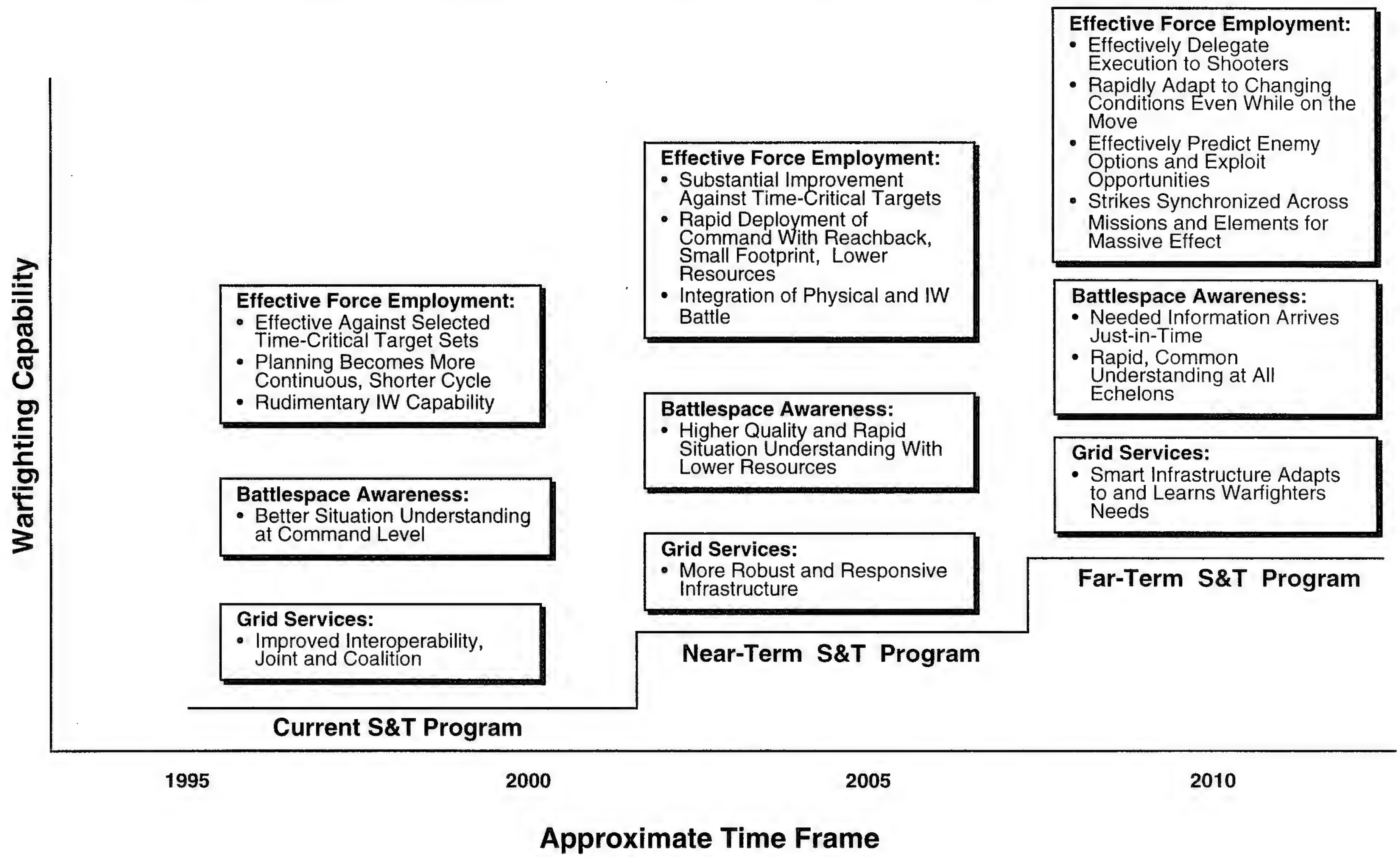
Sustaining overall advances in command and control system capabilities requires investment in a broad array of enabling technologies, as well as investment in experimentation and demonstration of potentially desirable command and control functional capabilities. Incremental technology advances will occur, and not all at the same rate, necessitating a time-phased approach to demonstrations and subsequent fielding. These demonstrations will need to encompass both technological and operational improvements, though both need not be emphasized in the same demonstration, much like ATDs and ACTDs have different emphases now.

This figure indicates those current demonstration programs judged fully supportive of the ABIS construct. The proposed near term demonstrations fill existing voids in functional capabilities with current and expected near-term technology. The demonstration of functional capabilities proposed for after the year 2000 requires significant advances in enabling technologies. Some of these are quite demanding and may not be fully achievable even in this time frame. Examples are mature automated reasoning algorithms, seamless networking, universal information transactions, and cognitive human computer interfaces. Nonetheless, it should be possible in this time frame to provide warfighters a more robust and flexible information environment in most situations as well as initial operational capabilities that effectively utilize reasoning algorithms and other cognitive aids.

The proposed demonstrations focus on broader operational and functional capabilities built by integrating a number of technology building blocks. System integration is an advancing technology itself and a challenging issue. The demonstrations are an important mechanism for accelerating the development of new operational concepts and the integration of new system capabilities. These demonstrations are aimed at validating operational value; refining the technical approach and operational concepts; and understanding system integration, architectural and doctrinal issues, and their interrelationship.

The indicated technology base areas, across the bottom of the figure, are areas in which advancement in capability is essential before the proposed demonstrations. These areas will require investment in technology by the DoD, as well as the private sector, before suitable and timely military applications can be made to create desired command and control capabilities. The row of dots at the right of the box indicates that many of the indicated technology areas will require sustained investment before the technology is mature; nevertheless, incremental demonstrations should be made of operationally meaningful capability improvements that ought to be possible through time.

Time-Phased Improvement in Operational Capability



Time-Phased Improvement in Operational Capability

Each step in the technology roadmap will provide a corresponding improvement in needed operational capability if integrated and fielded. This figure describes potential time-phased improvement leading to a fully realized ABIS by 2010.

Realization of the system level incremental improvements leading to the JCS joint vision of overwhelming dominance in the battlespace will require a continuing long-term commitment. These system efforts, coupled with the projected continued doubling performance of underlying information system hardware every 2 years, should result in significant incremental improvements in the warfighters' visibility and command of the battlespace as well as in the availability of accurate, detailed data needed for sensor-to-shooter concepts.

Between now and the year 2000, demonstrated capability improvements in force employment will be based largely on better target recognition and timely attack, beginnings of a defensive IW capability, and an improved planning capability. Battlespace awareness is to be improved by providing a consistent situational picture and an ability for integrated tasking of sensor assets. Grid capabilities will be improved to support rapid configuration of tactical networks and improved interoperability of radio networks.

In the midterm (2000-2005), further system improvements in force employment would be possible by wider dissemination of a commander's intent and improved C2 early in the campaign. Improved automated tools for weapon-to-target pairing and intelligence processing will allow substantial improvement against time critical targets. Battlespace awareness will be enhanced by continually projecting friendly and enemy moves and their outcomes, by adaptively supporting cognitive functions of diverse users, and by providing tailored information for mission execution when and where needed. Grid capabilities will be made more robust by advances in defensive IW, and by providing end users with an ability to tailor and adapt their information environment and access to information.

In the longer term (2005-2010), continued evolution of operational concepts and availability of new technology will provide a basis for full development of ABIS concepts.

Some Benefits of Pursuing the ABIS Concept

- **Provides Important *System Capabilities*, for Example:**
  - Separation of Command and Control Hierarchy From Information Access and Flow
  - User-Tailored Information Environments
  - Flexible, Robust, Information Services
- **Supports *Fundamental Changes in Command and Control* Concepts, for Example:**
  - "Intuitive Command" and "Common Understanding"
  - Continuous Forecast, Planning, and Assessment
  - Flexible Command Modes: Positive Control, Delegation, and By Negation
  - Improved Task Execution Through Leveraging of Information
- **Enables *New Force CONOPS* That Ensure U.S. Supremacy in Future Environments, for Example:**
  - Decisive Massing of Effects by Dispersed, Agile Forces
  - Ability To Prevail in Information Warfare Environment
  - Speed of Command

Some Benefits of Pursuing the ABIS Concept

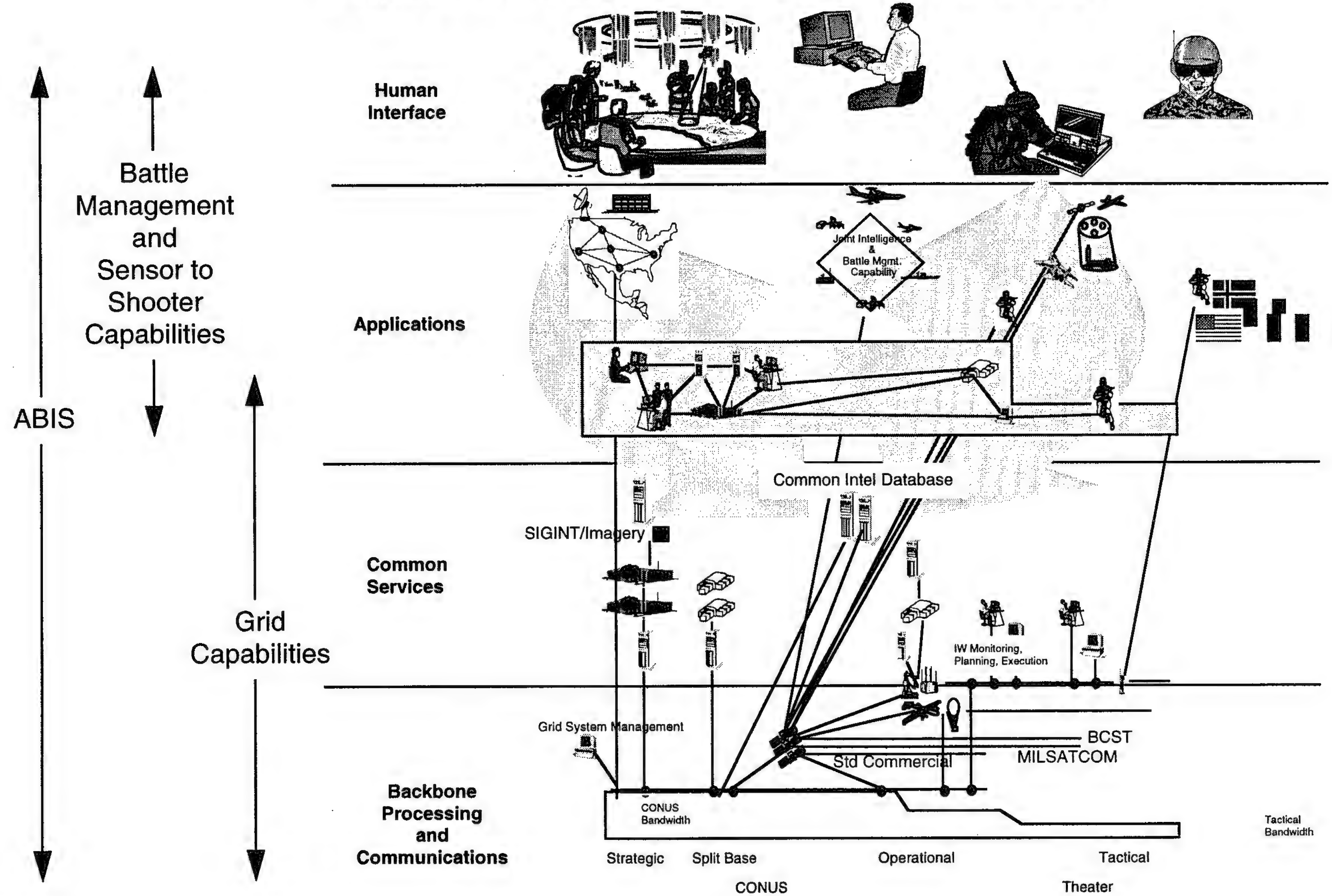
The figure summarizes important benefits of fully realizing the ABIS concept. Achieving important new system capabilities and fundamental changes in C2 concepts will enable new force-level operational capabilities and allow the United States to remain militarily dominant in the early part of the 21st century.

Annex C. System Opportunities and Challenges

System Opportunities and Challenges

The ABIS Task Force assessed future operating capabilities, critical C2 functions, and enabling technologies within a systems context. The scope of the ABIS effort did not include developing architectures or a system design. Nonetheless, many aspects relevant to architecture and design were discussed. This annex documents important points from these discussions for others who will be involved in ABIS architecture and system design efforts.

System Considerations
Layers of Opportunity and Challenge



System Considerations
Layers of Opportunity and Challenge

These figures provide a system perspective, layered to depict the human interface, applications, service, and backbone processing and communications functions.

The top layer is the interface to the users and maintainers. The human interface layer provides the displays and controls needed for situation assessment, planning, sensor management, force management, execution, and Grid management. These interfaces need to span users in environments that range from the cockpit and tank to the battle manager. One aspect of the system that has been described is the ability to provide information to the shooter during the mission execution. This additional data needs to be provided without distraction. The interest of the shooter is narrow in focus and deep in detail, as opposed to the planners' and battle managers' presentations that need to allow a view that is broad in scope, and occasionally deep in detail. The user interfaces for monitoring and maintaining the system will also need to be sophisticated because of the sophistication of the system. These interfaces are needed to provide access to the other three layers.

The second layer contains the applications that reside in the C4I systems. The applications layer provides the tailored capabilities needed for each node to perform its function. These capabilities support the battle management and sensor to shooter function directly. They also provide support to the development of the situation assessment, planning, force management, and execution. The wide, shaded arrows indicate information flow from the application layer to the Grid for storage and dissemination. Many applications provide machine intelligence and reasoning to support more rapid decision making with more information. This layer also provides the models and simulation accessed through the Grid. Each node and application of the system must contribute to, and be responsive to, the IW monitoring and protection function in the services layer. Some applications may be useful to a variety of functions. There may need to be a migration path from the application layer to the services layer as an application is identified to be able to support many other operational nodes.

The third layer is a set of common services. The service layer is the upper layer of the Grid. It provides capabilities that are needed and are common to many applications or that are needed at many application nodes. It also provides services that are needed to make the Grid more efficient or effective. Both the service and backbone processing and communications layers make up the Grid. The transaction oriented services in this layer make the system interoperable, efficient, and user friendly. Session oriented services support collaboration and mission rehearsal. These services need to be available to a wide variety of users from the Continental United States (CONUS) to the battlefield. Intelligent information retrieval and information repositories provide the common basis for consistent dominant battlefield awareness to all functions. IW protection is the monitoring, planning, and warning to decrease the risk of effective penetration. This will be a function that receives contributions from the layer above and the layer below.

Finally, the backbone processing and communications make up the foundation for the system and provide the ubiquitous communications that are a premise of the system concept. These communications include a variety of media, such as satellite communications, fiber optics, and radio frequency (RF), all functioning as an integrated system. It provides the processing assets needed for the services and can provide very high speed processors that are shared. The backbone provides sophisticated network management and the physical protection of the network from IW.

The following figures address the significant opportunities and critical challenges that the community will face in trying to implement each layer.

System Considerations Human Interface

Opportunity

- Tailored Interfaces for Tactical Environments
- Interfaces for Complex Tasks With Teradata

Challenge

- Developing General-Purpose Technology To Provide Interfaces for Dismounted Infantry, Tanks, Helicopters, Cockpits, Etc.
- Developing Ways To Display Uncertainty and Risk
- Developing Displays That Convey Knowledge, Not Data
- Developing Ways To Tailor Displays to Different Tasks and Different Ways of Thinking

System Considerations
Human Interface

The human interface is the top layer of the system construct/framework; the interface between the rest of the system and the users and maintainers of the "federated" Grid. It must allow the efficient interface, in both strategic and tactical environments, required to execute complex tasks involving teradata.

The major challenge to the Department of Defense (DoD) is to help develop enabling technologies that will allow interfacing from the highest command level, to the unit level, to the individual warfighter. There will be a need to provide and present to the user knowledge rather than data in a manner that adds value to battlespace awareness and understanding. The interface framework must enable the execution of "intuitive" command within the overall command and control (C2) concepts.

System Considerations
Applications Collaboration

Opportunity

- Distributed, Collaborative Teams Tailored to the Task

Challenge

- Ensuring That Decision Making, With More People and More Information, Happens Faster
  - Defining and Developing Tools To Support the Collaboration Process
- Training for Teams That Are Undefined
- Developing Trust and Cohesion Across Organizations and With New Players

System Considerations
Applications Collaboration

Three major applications are discussed in the next three figures: collaboration, modeling and simulation (M&S), and command, control, and intelligence (C2I) support.

The first application involves distributed collaborative planning, tailored to the task, in a heterogeneous information environment. At the top of the list of challenges, even though listed last, is the question of multilevel security (MLS) control and dissemination. Further, MLS is critical to efficiently fuse information to achieve consistent battlespace understanding. MLS is important to gain user confidence on the validity and credibility of the data regardless of source so that the user is willing to execute on the basis of what is presented and displayed. This function will require efficient and effective distributed database management throughout the command and control and a common information taxonomy. The two remaining applications will be briefly summarized immediately after the particular application figure.

System Considerations
Applications M&S

Opportunity

- M&S Available To Support C2I Decision Making
- Ability To Use Other M&S Nodes

Challenge

- VV&A for Models for Distributed Use
- Developing Models of Human Decision Making
  - Friendly Force
  - Adversarial
  - Tailorable
  - Non-Military Entities
- Defining and Developing Means for Model Output To Be Understood
- Developing the M&S Infrastructure

System Considerations
Applications M&S

The second major application, modeling and simulation (M&S), will be useful only if it directly supports the C2I decision process. The application construct must allow for integrating distributed M&S nodes.

The technical challenge to DoD is to first develop the required M&S infrastructure that is effectively reachable through a federated heterogeneous information environment. The output of various models and M&S nodes must be understandable, acceptable, and viewed as credible by the user. These models should simulate friendly and adversary forces, noncombat entities, and be tailorable to the current task.

System Considerations
Applications C2I Support

Opportunity

- Information Mining of Many Sources
  - Automatic Filtering
  - Automatic Search and Retrieval
- Replace Many Slow, Labor Intensive Processes With Automated Processes

Challenge

- Developing Smart Information Filters
- Developing General-Purpose Intelligent Agents That Can Be Trained To Support Different Tasks and Echelons
- Developing General-Purpose Engines for Decision Support
- Developing Techniques for Automated Inferencing and Image Processing

System Considerations
Application C2I Support

The third application involves providing C2I support to all operational levels, for example, from Joint Task Force commander, to the particular organization, and to the individual warfighter. The application will require aggregating and efficiently exploring a variety of sources in a construct that will de facto replace slow, labor-intensive processes with automated processes.

The challenges to the DoD involve the development of trainable/intelligent agents that efficiently support a broad spectrum of tasks over all command echelons. The use of smart data and information filtering techniques will be absolutely necessary. Further, techniques must be developed for automated inferencing and image processing combined with general purpose engines (from artificial intelligence) for decision support.

System Considerations
Services Information

Opportunity

- Distributed Fused Theater and Intelligence Databases With Distributed Sources
- Information Repositories
  - Developed and Maintained by Responsible Organization
  - Provide Support to Both Pull and Push

Challenge

- Finding, Deconflicting, and Fusing Information
- Getting Information Sources To Share Information
- Gaining User Confidence in Nonorganic Data
- Maintaining Information of Source Data Tags for Data Quality and Data Characteristics
- Controlling Security for Combined Information That Has a Higher Security Level Than the Individual Contributors

System Considerations
Services Information

There are two major services: information and support (backbone communications). With respect to information services, the opportunity and need are to achieve distributed fused theater/intelligence databases from multiple and distributed sources and the efficient management of both distributed sources and distributed data repositories that will provide "pull and push" of information to the warfighter.

The challenges to the DoD include achieving multilevel security and dissemination, distributed/efficient database management systems, search/retrieval and exploitation of distributed sources, and gaining user confidence on the validity and credibility of the data. Another challenge involves the elimination of organizational barriers to permit information sources to share information with each other.

System Considerations
Services Support

Opportunity

- Distributed Shared Work Spaces
- Modeling and Simulation Services
- Personal Addressing Delivers Information Regardless of Location
- Geolocation and Timing Services

Challenge

- Developing Interfaces to Heterogeneous Systems—With Significant Reusability
- Defining and Providing Needed General-Purpose M&S Support
- Working With Federation Members To Develop Protocols and Standards for Personal Addressing
- Developing Mostly Reusable Translators for Legacy Information Delivery Systems
- Building Robustness into Geolocation
- Finding Ways To Handle Varying Location Accuracy Requirements

System Considerations
Services Support

The second service in the broad support area involves the ability to provide distributed, shared work spaces throughout the federated information Grid. In this construct, a personal addressing scheme should permit the delivery of information regardless of location. It will be important to provide geolocation and timing services as well as M&S services to the highest quality level.

The technical challenges involve not only the development of the "articles of the federation" to permit federation members to develop protocol and standards for personal addressing but also reusable interfaces to heterogeneous systems. Other challenges include building robustness into geolocation, handling various location accuracy requirements, and providing general-purpose M&S support.

System Considerations
Backbone Communications

Opportunity

- Provides the Physical Connections Between the Federated and Heterogeneous Systems
- Consists of Massive Heterogeneity Consisting of
  - Legacy Systems
  - Commercial Systems
  - Emerging New Systems
  - Allies and Coalition
  - Non-DoD

Challenge

- Developing Interfaces, Protocols, and Translators to Interface Legacy Systems
- Working With Federation Members To Develop Protocols and Standards
- Developing Modular Interfaces To Allow Quick Interoperability

System Considerations
Backbone Communications

The backbone communications that constitute support services will provide the physical connection between the distributed members of the federated and heterogeneous system. This massive, distributed, heterogeneous system will be composed of a large variety of different systems: legacy systems, commercial systems (U.S. and foreign), emerging new systems, allies and coalition, and non-DoD (such as CIA).

The challenges to DoD include working with federation members to develop procedures, protocols, and standards; developing modular interfaces to allow quick interoperability; and developing interfaces, protocols, and translators to interface a large number of legacy systems.

System Considerations
Backbone Robustness

Opportunity

- Robustness From
  - Use of Alternative Physical Paths
  - Available Substitute Platforms, e.g., UAV Communication Extensions
  - “Front Ends” and Shells for Adding Robustness to Commercial Products
  - IW Protect New Sensors

Challenge

- Setting Fair Rules for Network Sharing in Emergencies
- Providing Confidence to Communities So That They Will Be Willing To Pool Resources
- Keeping Communications Extensions Available to Tactical Users
- Developing the Technology for Front Ends
- Defining Requirements for IW Sensors That Are Compatible With All Nodes and Networks

System Considerations
Backbone Robustness

The DoD is being presented a great opportunity to achieve backbone robustness through a variety of approaches. These approaches include using alternative physical paths and providing connectivity via communication extensions using available substitute platforms (e.g., UAV). Robustness can be achieved by taking advantage of commercial products through the development of tailored "front ends" and shells. In addition, the development of information warfare (IW) protect sensors is a major tool against offensive operations by the adversary.

The challenge to DoD is multifaceted and involves political, and policy and technical considerations. From a national communications perspective, it is essential to develop rules for network sharing. This is particularly crucial because the U.S. Government plans to allow foreign telecommunication firms to compete in the domestic market. Other challenges include providing confidence to various communities so that they will be willing to pool resources, keeping communication extensions available to tactical users, developing the technology for front ends, and defining requirements for IW sensors that are compatible with all nodes and networks.

System Considerations
Backbone Processing

Opportunity

- IW Monitoring and Modeling
  - Plan for Active and Passive Defense Efforts
  - Provide Tools To Recognize Hostile Source and Intent
  - Cooperates With Service and Application Layers
- Systems/Network Management
  - Status Information From All Elements
  - M&S to Project Network
  - Cognitive Support—Decision Aids and Displays

Challenge

- Identifying the Needed Information and Messages From Each Node For
  - IW Protection
  - System Management
- Developing Modular IW Monitoring Inserts for All Nodes
- Developing the IW and System Management Data Exchange Standards
- Developing the Models To Project Network Status Based on Operational Situation and Events

System Considerations
Backbone Processing

The two major opportunities for the DoD involve IW monitoring and modeling, and systems/network management in future advanced information systems framework and architecture. The IW monitoring and modeling must plan for active and passive defense efforts, provide the tools to recognize potential hostile source and intent, and permit efficient cooperation with the service and application layers. The systems and network management must be able to respond to current situations and projected future needs. Management and IW protection need to be strongly integrated to enable the Grid to adapt to attacks, to mitigate damage, and to restore services according to operational priorities.

The challenge to the DoD is multifaceted: identify the essential information and messages from each node from both an IW protection and a system management viewpoint; develop modular IW inserts for all nodes; develop IW and system management data exchange standards and approaches; and develop models to ascertain network status as it changes during the operational situation and related events.

Annex D. Process for ABIS Evolution

Process for ABIS Evolution

This annex outlines current key problems in moving from a focused set of technology initiatives to deployed operational capability, and evolving the details at the architecture and systems level to realize the ABIS construct. It proposes specific process changes and the widespread use of testbeds to integrate the efforts of the operational and technical communities.

Key Benefits of Pursuing the ABIS Concept

- Provides Important System Capabilities, e.g.:
  - Separation of Command and Control Process From Information Access and Flow
  - User-Tailored Information Environments, Supported by National, Theater, and Tactical Assets
  - Flexible, Robust Information Services
- Supports Fundamental Changes in Command and Control Concepts, e.g.:
  - "Intuitive Command" and "Common Understanding"
  - Continuous Forecast Planning and Assessment
  - Flexible Command Modes: Positive Control, Delegation, and by Negation
  - Flattened C2 Structure with Adaptive Processes for a Learning Organization
- Enables New Force Level Operational Concepts That Ensure U.S. Supremacy in Future Environments
  - Improved Task Execution Through Leveraging of Information and Empowered Execution
  - Decisive Massing of Effects by Dispersed, Agile Forces
  - Ability To Prevail in Information Warfare Environment
  - Speed of Command

Remaining Militarily Dominant in the Early Part of the Twenty-First Century Requires the U.S. Military To Assimilate and Use ABIS Concepts to Advantage in the Field

Key Benefits of Pursuing ABIS

ABIS addresses enhancements in warfighting effectiveness and efficiency over the long term through an orderly sequence of actions to adapt operational concepts and procedures, and information technology to the emerging national security environment of the next century. Each step in this sequence, or roadmap, is intended to provide both evolutionary and revolutionary improvements in a way that can be accommodated within the existing operational and technical frameworks. The challenge is to define appropriate time-phased goals and to coordinate the development and assimilation within the forces of the operational concepts and the technologies consistent with the long-term objective.

The bullets in this figure denote the focal points of the concept. In each area, the long-term objectives are aimed at revolutionary enhancements that may result in fundamental changes in the way that forces are organized, commanded, and operated. In some cases, changes to basic doctrine and even roles and missions may be needed. These changes will have to evolve in a way that is suitable to the warfighters and that does not compromise the existing state of readiness of the forces. In other cases, the changes may be enhancements in processes or systems that are compatible with existing doctrine.

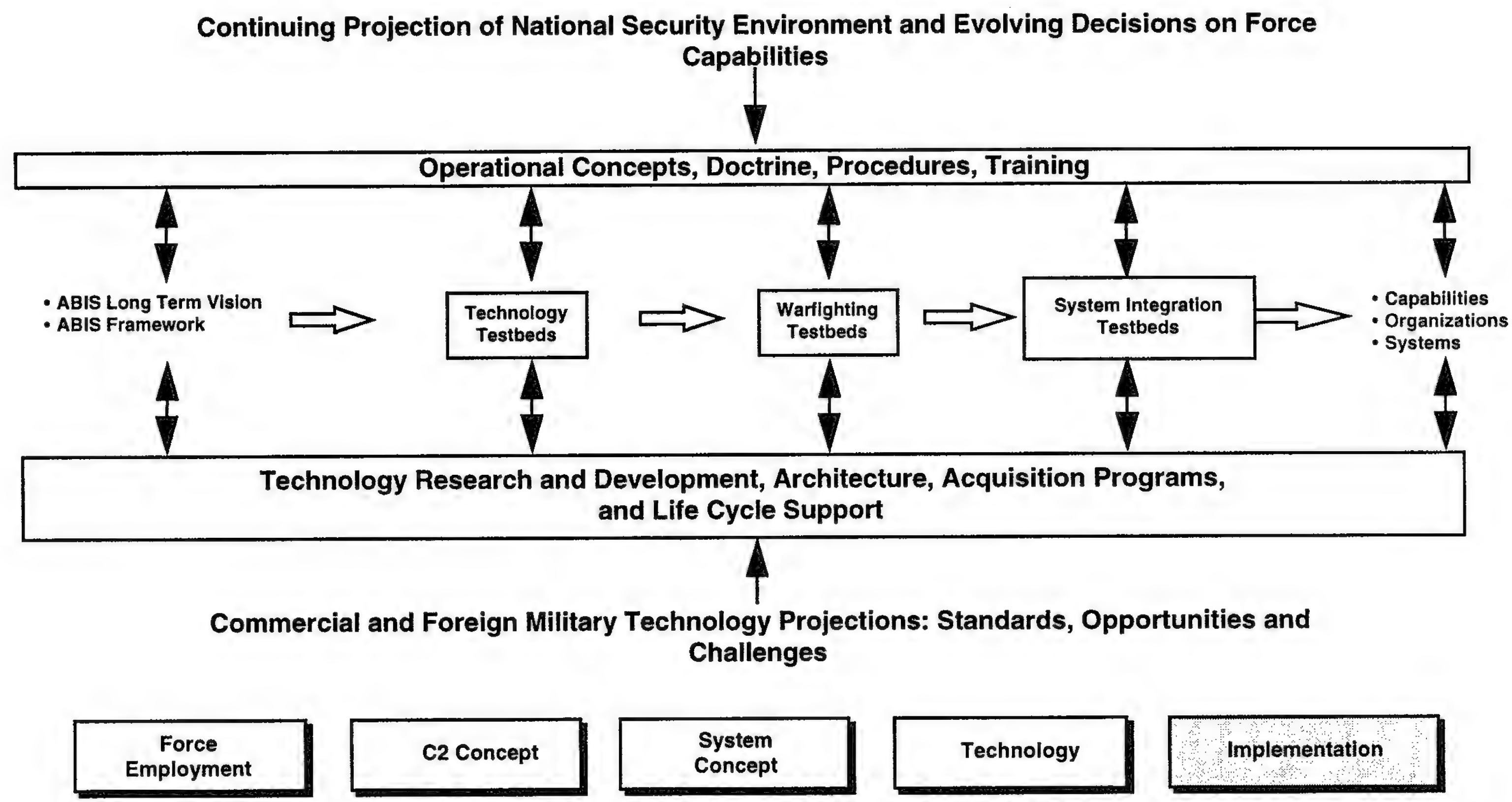
Clearly, implementation of such an ambitious and “politically charged” initiative will be difficult. The substantial benefits offer potential reductions in costs through extensive automation of processes that are now laborious and time consuming. The benefits also offer speed and flexibility in organizing, deploying, and operating forces and in the application of expensive but highly effective weapons and sensors. The capabilities derived from the benefits can be the basis of military advantage within a battlespace. However, these benefits will not be realized without some pain. DoD will have to finance new technology to replace existing systems, and the funds will have to be taken from the shrinking budgets being divided among current programs. The operators will also have to be committed to revising concepts, doctrine, and organizational structures that are strongly embedded in military culture and practice.

Motivation toward the objective and willingness to confront and solve difficult problems are summed in the assertion at the bottom of the figure. The United States must remain militarily dominant in any future conflict, and to do so we must take advantage of the information technology “explosion” as a way to provide an efficient and cost-effective military capability and to keep ahead of potential adversaries who have access to the same commercial information technology.

The following discussions address the approach and strategy for moving toward the ABIS vision.

ABIS Evolution Process

Fielding ABIS Capabilities Requires Incremental Insertion, Adaptation, and Assimilation of New Operational Concepts and Technologies, Guided by a Single Long-Term Vision and a Broad Community of Participants



ABIS Evolution Process

Moving from operational concepts and technology programs to broad scale implementation and user assimilation represents a major challenge. Together the operational and technical communities are capable of better judgments than either is alone. This is a powerful lesson learned by the ABIS Task Force. The approach must be evolutionary, and keep envisioned operational capabilities well coupled with the best judgment of the technical community as to what will be attainable at any given time.

The process illustrated in the figure ensures this coupling and the participation of other players necessary for the evolution of ABIS. As depicted, the ABIS vision and framework drive operational concepts and technology that are shaped over time by feedback from testbeds aimed at determining feasibility and operational effectiveness. The testbeds serve as laboratories where operators can experiment with new technology within a simulated real-world operational context to determine the extent to which technology will support needed command and control functions and enable new operational concepts. Also testbeds can be used to understand systems integration and procedural impacts of inserting new capabilities into evolving systems. These testbeds may be single locations, such as a battle lab, they may be distributed across several locations, or they may be electronically linked locations. The demonstrations in the ABIS roadmap would generally be done within an integrated operational-technical testbed.

The horizontal bars at the top and bottom of the figure indicate the continuous interaction of the broad operational and technical communities. The intent is to provide rapid and smooth transition from advanced concept exploration through broad system implementation, life cycle support, and operational training within a common ABIS framework. In addition, a process is required that focuses on coordinating planning, architecture, and collaborative integration and evaluation activities with rapid incorporation of capability improvements into system acquisition, life cycle support, and training programs.

This process implies a very strong integration of activities among organizations on the operational and technical sides of DoD as well. On the technology side, the R&D community will have to work closely with acquisition and life cycle organizations. On the operational side, advanced concepts and doctrine development will have to be matched by education, training, and exercise to assimilate the new capabilities into the operational forces.

The ABIS vision and framework provide a focus for these interactions as well as the selection of technology and operational concepts.

Implementation Principles

- Coordinated Operational and Technical Evolution
  - Experimentation, Evaluation, and Feedback To Expedite and Validate New Concepts, Requirements, and Technical Approaches
  - Integrated Operational and Technology Planning
- DoD Guidance To Enable and Expedite Progress
  - A Long Term "Vector" Toward the Vision
  - Incremental Goals With Migration Strategy
  - Evolutionary, Time-Phased Joint Architecture
  - Focus on Federated, Heterogeneous Capabilities
- Operational Concept Development To Assist Technology Assimilation
  - Operational Experimentation To Refine Concepts To Lead Insertion of New Technology Into Operational Environment
  - Education to Train Users and Adjust Processes and Procedures
  - Exercises To Build User Proficiency and Confidence
- Coordinated Technology Development, Acquisition, and Life Cycle Support
  - Early and Continuing Partnership With the Acquisition, and Support Commands
  - Acquisition and Life Cycle Support Integral to Technology Initiatives
  - Test and Evaluation, and Contracting Need To Support the Process

Implementation Principles

The principles listed in this figure are central to the evolution process.

Coordination, or more properly integration, of the operational and technical evolution processes is essential. Mechanisms must be set in place to ensure integration. The ABIS Task Force was an important first step, but is insufficient by itself. More substantial efforts to establish and maintain close coupling between the operators and system developers needs to extend from planning and budgeting to program execution and operational practice.

DoD guidance is another essential part of the process. Guidance needs to balance both the forward look toward the vision and the near-term focus on readiness, sustainability, and interoperability among existing forces and systems. The long-term vision is the ultimate goal of evolution, but the steps toward that goal need to be incremental, along the proper vector and consistent with DoD's ability to insert and assimilate the enhancements. We will need a time-phased architecture and a view toward managing the complex system-of-systems in ways that support both current capabilities and future enhancements. We cannot afford to be too constrained by current concepts and systems, but we also cannot afford to ignore the realities of the difficulty of new investments and the need for sustainability and interoperability at each stage. DoD guidance must accommodate and facilitate a system-of-systems in which heterogeneity and continuous change are principal factors.

As new capabilities are developed, they must be inserted and assimilated into an operational environment that includes both users and systems that work together according to well-defined concepts, procedures, and practices. The enhancements will influence how tasks are executed and how people and systems interact. Education, training, and exercises will play important roles in assimilating the capabilities. They must precede the introduction of the new equipment and concepts so that the forces can adapt quickly and efficiently, and overall readiness is always maintained and improved.

The vital role of the materiel community in ABIS evolution is evident. This community acquires, fields, manages, and sustains the systems. Current DoD processes tend to separate acquisition and life cycle support from advanced research and development. The result is often a decoupling of the technology vision and the corresponding advanced operational concept vision from the reality of the system acquisition process. Advanced prototypes and concepts are developed, and sometimes even fielded, and often become "orphaned" or are not interoperable with existing systems. This needs to be changed. We need to accelerate "technology insertion" and acquisition of state-of-the-shelf technology, and we need to do it in a way that ensures reliable life cycle support and end-to-end system integrity and interoperability.

Integrated Operational and Technology Planning

- Integrated Planning of Both Operational Concepts and Technological Initiatives
- Continuous Update of Plans Through User-Developer Evaluation and Feedback
- Defined Objectives and Measures of Success, With Specificity Matched to Time Frame: Specific for Near Term and General for Longer Term
- Continual Process With Sufficient Flexibility To Accommodate Rapid Technology Advances
- Operational Capability Enhancements Achieved by Packages of Technical Enhancements

Integrated Operational and Technology Planning

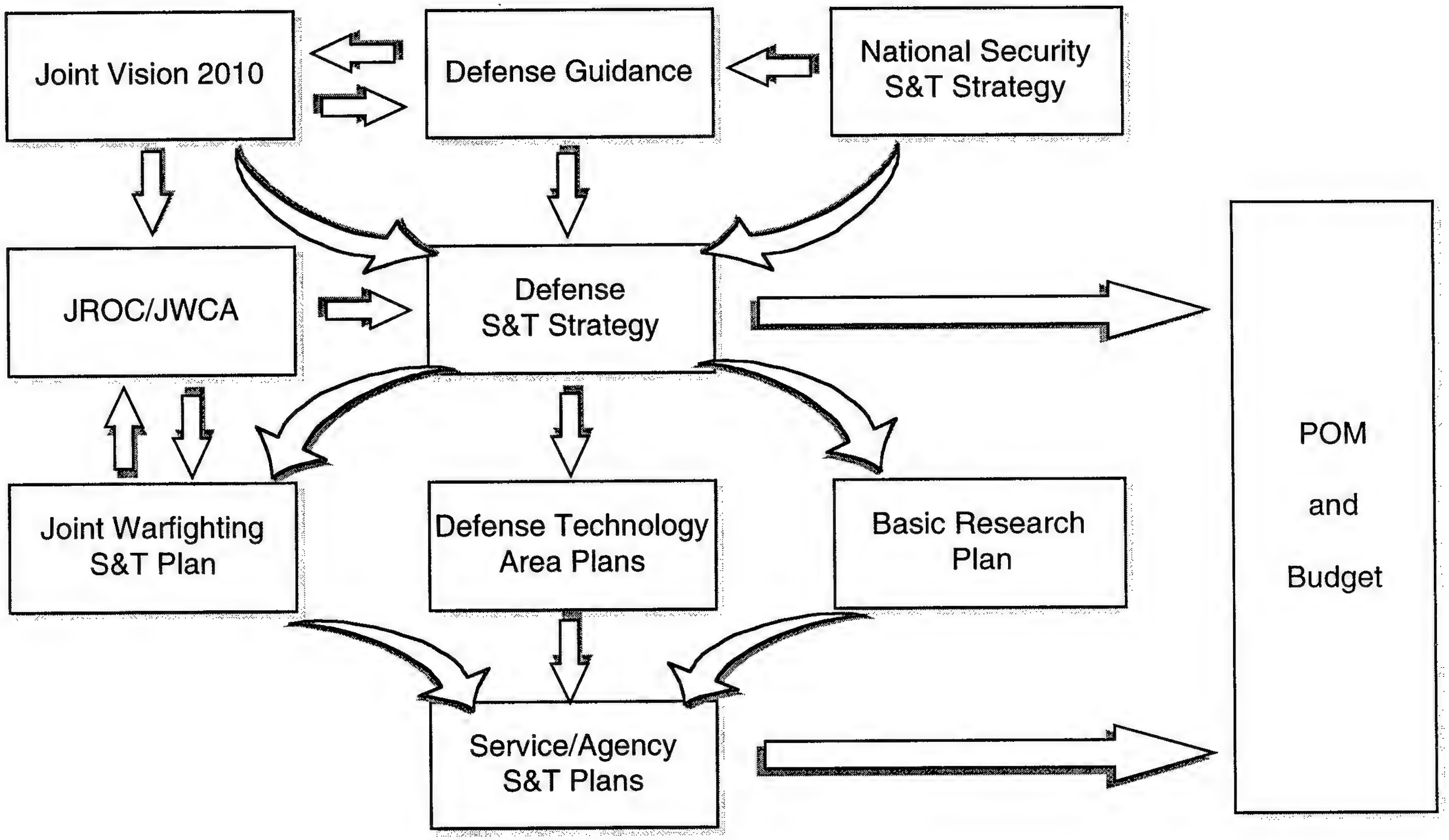
A key principle in the strategy is to collaborate across the operational-technical interface to achieve an iterative process for developing both operational concepts and technology programs that address a common objective. The first two bullets in this figure express that principle in the form of integrated planning and continuous adaptation, based on user trials and evaluations. This allows development of requirements based on visibility of the anticipated products and also management of the emergence and maturing of technology products to suit the operational priorities.

The third bullet addresses a need to focus on specific actionable objectives that have significant measurable operational payoff in the near term, even though the overall ABIS objectives are far broader and focused on the longer term. Military readiness is always focused on the present or near term, and the ABIS evolution initiatives must make measurable contributions in that time frame. The process of "building a little, testing a little, and building some more" addresses the need to maintain and improve readiness and to clarify longer term goals.

Commercial information technology is likely to continue to advance rapidly and sometimes in totally unexpected ways. ABIS evolution needs to adapt and take advantage of this dynamic and unpredictable environment. The strategy needs to be "opportunistic" and agile rather than "deliberately planned" to reach some predetermined objective, especially in the mid to long time frame, but to some extent even in the near term. New products must be inserted for trial and evaluation even if they have not been in the original plans, and user feedback from these trials must be disseminated to the commercial developers so that they have visibility into the DoD market for potential new products. The process is a continually adaptive one, even though it may contain sequential steps from technology demonstration, to concept development, to product development.

The technology products need to be grouped into packages that provide operational capability enhancements, not just technology improvements. This is particularly challenging for organizations like DoD that subdivide efforts into well defined, bounded pieces. In the DoD S&T world, those pieces are usually specific technology areas, such as high-speed networking or automated image understanding. In fact, the operational capabilities arise from combinations of several technologies, not from a single one. A high-speed network has limited value unless the power of that network can be used to support a process or application that needs the high-speed services. Operational concepts and capability packages need to be developed by integrating across technical areas, and the ABIS evolution process must focus on the integrated operational capability, not just on the individual technical enhancements.

Planning


Joint Vision 2010
Defense Guidance
National Security S&T Strategy
JROC/JWCA
Defense S&T Strategy
POM and Budget
Joint Warfighting S&T Plan
Defense Technology Area Plans
Basic Research Plan
Service/Agency S&T Plans

DoD Planning Process for Science and Technology

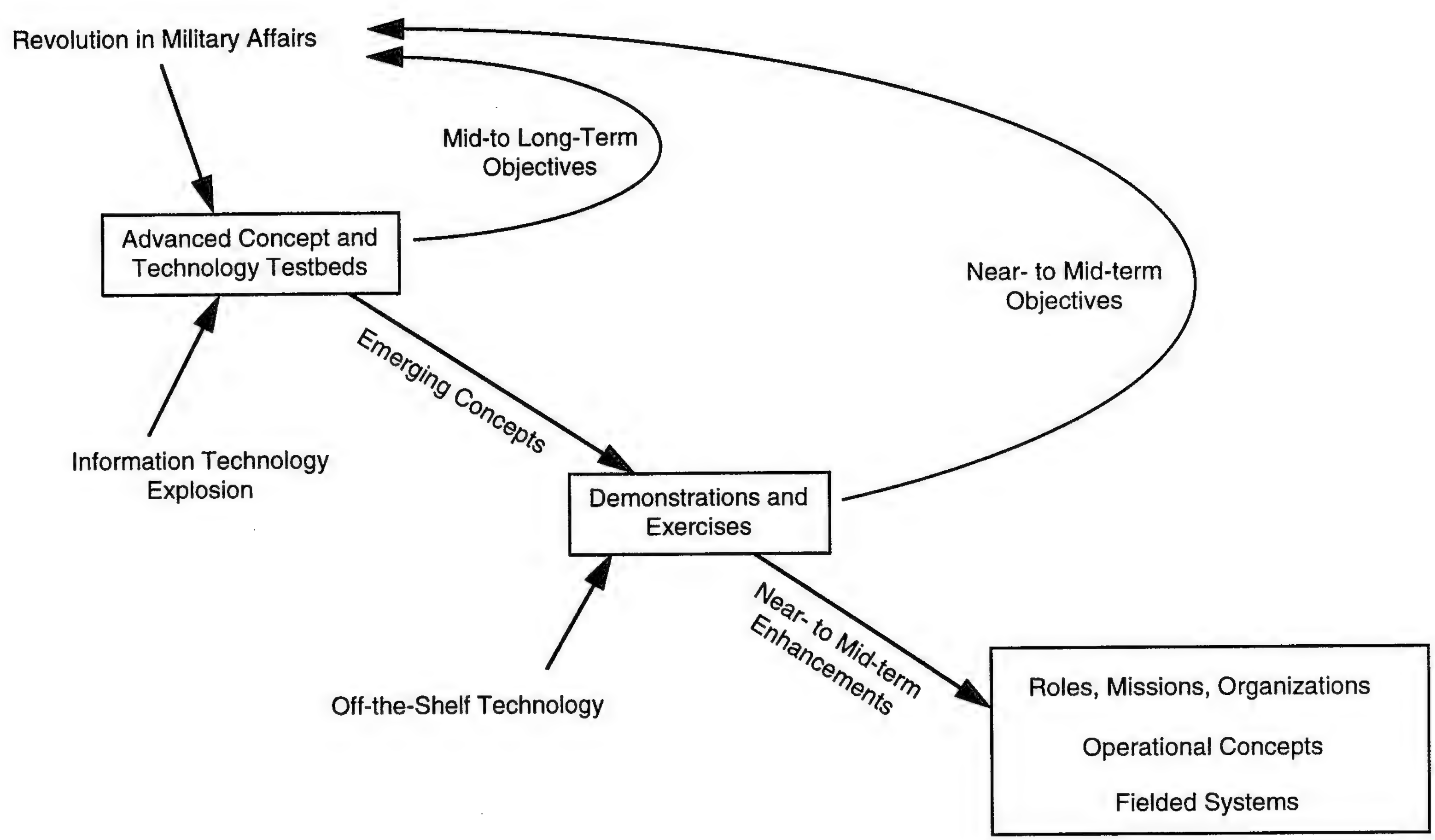
Evolution toward the objective will be guided by planning processes that shape DoD policies and investments, based on the integrated operational-technical vision. High-level guidance is provided by a combination of joint operational vision, defense guidance, and national technology strategy. These combine to produce an overall definition of joint operational requirements and priorities and an S&T strategy for DoD, which are the basis for developing POM guidance. The Joint Requirements Oversight Council (JROC) plays a pivotal role in interpreting high-level guidance in terms of requirements and priorities and interacting with the technology and acquisition organizations in DoD to develop the strategy and to validate its objectives and priorities. The overall S&T strategy is not static. It will evolve in concert with evolving operational and technical visions and objectives, developed and coordinated through the extensive experimentation and evaluation processes shown in the preceding figure. Consequently, the S&T strategy provides POM guidance that tracks and expedites evolving concepts and is, therefore, a critical element in support of the Revolution in Military Affairs (RMA) process within DoD.

The S&T strategy also drives the development of the three focal area plans shown in this figure: the Basic Research Plan, the Defense Technology Area Plans, and the Joint Warfighting S&T Plan. These plans interpret the S&T strategy in terms of specific objectives and investments to develop critical enabling technologies that can be used to build systems that provide required functional capabilities, and to integrate across technology areas to build operational capabilities.

Each of the three focal area plans presents an integrated, joint view of the needed technology investments and objectives. They are the drivers for the service and agency S&T plans that are the actual investment planning inputs to the POM. The services and agencies are usually also the executive agents for building systems. They define objectives and funding requirements for S&T to carry out its part of the process. The S&T inputs to the POM process provide the specific definition of actions and resource requirements to support the higher level guidance provided in the S&T strategy.

ABIS has already had an impact on various planning and decision support processes within DoD. It has acted as a catalyst to bring together some of the processes and to initiate or invigorate others. Preliminary ABIS results have been incorporated into the JROC's Joint Warfighting Capability Assessment (JWCA) process, the Joint Warfighter S&T Strategy Plan, and the Defense Technology Area Plans. They are also being used in the C4ISR Operational Architecture Effort and as an input to Project Gabriel, the plan for a new Joint C4I Battle Center for advanced concept and technology experimentation. ABIS results are broadly visible within DoD and will support the development of the emerging Joint Technical Architecture and the Joint C4ISR Decision Support Center.

Continuous Refinement of Objectives and Approaches



Continuous Refinement of Objectives and Approaches

This figure illustrates the mechanism whereby incremental demonstration and evaluation can be accomplished as part of a continuously adaptive evolution process. The notion of concurrence in developing concepts and technology solutions should not be interpreted as a unplanned process. Some degree of serial progression from advanced concept through demonstration and implementation is still required, but the process can be steered by continual feedback at each stage.

The figure shows two distinct feedback loops. One occurs when the current view of long-term concepts and objectives is combined with visibility of the emerging technologies. This provides the operators and developers with the opportunity to test and evaluate the potential operational benefits of the projected technology. The technology can be adapted to current processes to improve them, and new operational concepts enabled by the advanced technology can be tried. The feedback can identify future objectives that can guide the revolution in military affairs, keeping its long-term vision abreast of the trends in both the operational and technical worlds.

The second feedback loop also supports development and refinement of guidance to evolve military concepts and systems. In this case, the feedback is oriented more to the near term (although it has long-term aspects as well) and reflects the new concepts and technologies that are being tried just prior to insertion into the operational environment. The users and developers test and evaluate new concepts and off-the-shelf technology that have been judged in prior evaluations to offer important enhancements to operational capability. Based on these trials, some concepts and technologies will make the transition to the operational systems, and the operators' perspectives on concepts and systems will be fed back into the basic guidance in terms of near-term to midterm goals and objectives as well as residual needs.

In this way, the serial steps from advanced operational concepts and technology to specific enhancements is wrapped within a continuous and concurrent process of test, evaluation, refinement, and adaptation of vision and guidance.

The ultimate message is that we need to progress from thinking in terms of "requirements pull" or "technology push." The new process must combine the operational and technological viewpoints so that there is a common motivation to adjust concepts and systems based on a view of the future on both sides. In addition, it can be anticipated that the process itself will work better and faster because the user and developer together will be having "hands-on" experience providing a common framework for discussion and change.

Concept and Technology Demonstrations and Experiments Are Core Elements in the Process

- Advanced Warfighting Experiments (AWE) To Evaluate New Capabilities and Identify Ways To Insert and Integrate These Into Baseline Systems and Operational Concepts
- Advanced Technology Demonstrations (ATD) To Appraise Both Technical Maturity of New Technologies and Potential Operational Benefits
- Advanced Concept Technology Demonstrations (ACTD) To Establish a Basis for the Introduction of the New Capabilities by Evaluating a Technology's Military Utility, Developing Concepts of Operation, and Retaining a Low-Cost Residual Operational Capability

Concept and Technology Demonstrations and Experiments Are Core Elements in the Process

Concurrent evolution of the operational concepts and technology requires the ability for users and developers to conceive and evaluate new constructs that appear to offer operational benefits. This can be accomplished through various types of demonstrations and experiments. When used to their fullest extent, coordinated and properly structured, these can be an integral part of the formal requirements process. Three types of demonstrations and experiments are listed in this figure.

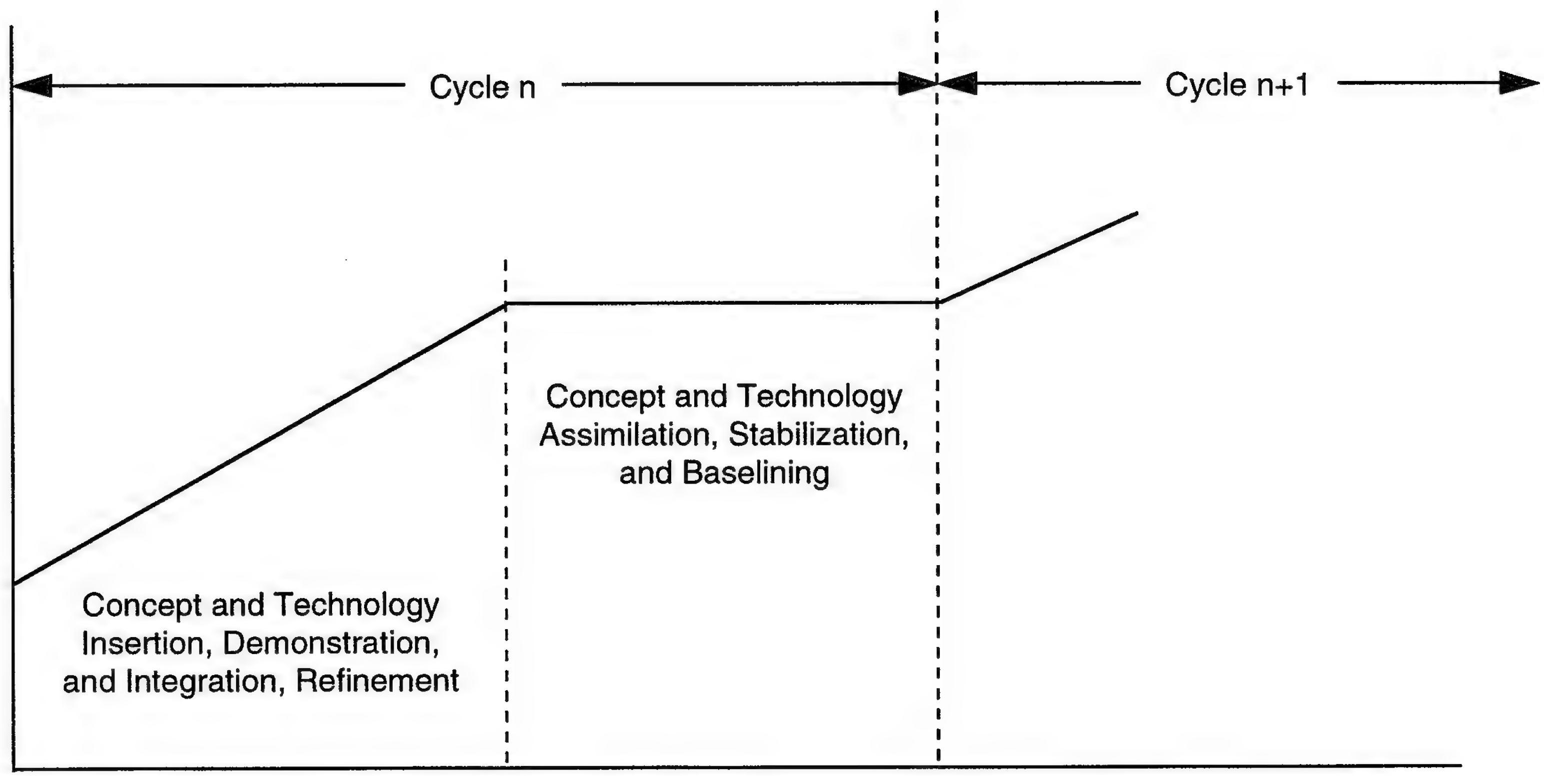
Advanced Warfighting Experiments (AWE) are the warfighters' mechanisms for assembling the proposed technologies and concepts into capability packages that address specific operational needs. These experiments allow the warfighters to evaluate strengths and weaknesses so that they can make decisions on concepts and investment strategies for the near to midterm. AWEs allow users to validate the need and worth for proposed new systems, and they can provide a basis for development of new operational concepts that can lead the introduction of the new systems. This is an essential part of the process to produce a common motivation toward the future rather than the traditional requirements push. AWEs can be very flexible and can address time frames ranging from the very near term to the midterm. They can include demonstration and evaluation of advanced concepts and technologies, including participation of ATDs in the experiments, and they can address more near term initiatives, such as the ACTDs.

Advanced Technology Demonstrations (ATD) are the means to explore the application and technical maturity of technology emerging in the military and commercial marketplaces. The purpose is to judge the technical feasibility and the potential value to support operational concepts, so that further investment decisions can be made based on the users and the developers hands-on feel for the technology. An ATD is not only a feasibility demonstration. It also guides the operators' thoughts about opportunities to apply technology to change the way that they do business. An ATD provides insight into both the applicability of emerging technology within the current operational framework and the opportunity to use technology to change the framework. Feedback to advanced planning organizations such as the Joint Requirements Oversight Council (JROC) can help guide the RMA by providing continuous update and clarification of the likely future environment.

Advanced Concept Technology Demonstrations (ACTD) are the mechanism to validate the military utility of a proposed operational capability enhancement, and its engineering and manufacturing practicality. When the technology is demonstrated to be sufficiently mature, and when the users have developed concepts for deriving operational value from that technology, the ACTD is a final step to demonstrate that the capability is worthy of implementation. The fundamental purpose of the ACTD is to demonstrate that the technology is ready to field, is matched by suitable operational concepts, and is a reasonable extension from the current baseline systems. That is why it is possible to retain a residual operational capability from the ACTD.

Incremental Evolution Cycles

Establish Incremental Enhancements That Allow the Technology and Concepts To Be Iterated, Adapted, Assimilated, and Stabilized Before Introducing the Next Round of Major New Departures



Incremental Evolution Cycles

The notion of incremental evolution and cyclic adaptation of concepts, technologies, and plans is central to the ABIS strategy. We cannot simply set goals for the year 2010 and start to build a long-term objective system. This is one of the key problems with traditional approaches that rely on deliberate planning for 10 or more years into the future. Instead, we need to recognize that movement toward the long-term objective must be accomplished in steps that are small enough that the operational and technical goals can be well defined, and the achievements can be assimilated before embarking on the next step. The long-term vision and objectives are targets on the horizon, and the incremental steps lead to waypoints along the course. Over time, as technologies mature at different rates and warfighters' needs change, the planned intermediate steps and perhaps even the end target itself will need to be changed.

The objective of each increment is to implement a significant enhancement to operational capability, consistent with the long-term objectives, and to assimilate that enhancement into the operational and technical baseline. This involves two distinct phases, as indicated in the figure. The first phase is to establish the specific concepts and technologies that will be implemented during the cycle. This includes iteration of the operational and technical views of near- to mid-term needs and opportunities. It results in a combined requirements push and technology pull that produces goals that are somewhat broadened from the baseline operational perspectives and somewhat bounded from the unconstrained technology perspective. During this first phase, the ATDs, ACTDs, and AWEs are accomplished through a series of controlled demonstrations and warfighting experiments. The second phase concentrates on bringing the new operational concepts and the new system enhancements into the operational environment. The "baseline" concepts and systems are evolved to assimilate the new increment. This process involves developing doctrine and concepts and training operational units. It also involves inserting the technical elements into the formal materiel chain to ensure appropriate life cycle support and to ensure interoperability with existing and planned systems. Although all of this needs to occur repeatedly over the relatively short time span of a few years, each step needs to be accomplished.

Subsequent cycles build on prior ones, leading toward the longer term objectives. At each stage, feedback to warfighters and developers can adjust that long-term vision, as noted earlier; therefore, the process becomes an adaptable one that combines an element of preplanning and "bootstrapping" to suit changing needs and perspectives.

Although this figure indicates a serial process in which each cycle ends before the next begins, it is evident from prior discussion that the subsequent cycles begin concurrently with the execution of current cycles, at least at the advanced concept stage. The figure mainly denotes the execution stages during which the main demonstrations and the assimilation are carried out.

Key Elements in the Cycle

- Integrated Concept and Technology Evolution
  - Operational Concept Development and Refinement
  - Operational Concept and Technology Alignment
  - Technology Development and Demonstration
  - Capability Demonstration, Evaluation, and Adaptation
- Orderly Transition to New Systems and Concepts
  - Architectural Guidance
  - Adjustments to Doctrine, Procedures, and Functional Processes
  - Interoperability Among Existing and Future Systems
  - Full Life Cycle Management: Acquisition, Integration, and Support
- Operational Capability Assimilation
  - Assimilation and Baselining of Systems
  - Adaptation of Concepts and Procedures
  - Training and Practice in New Concepts

Key Elements in the Cycle

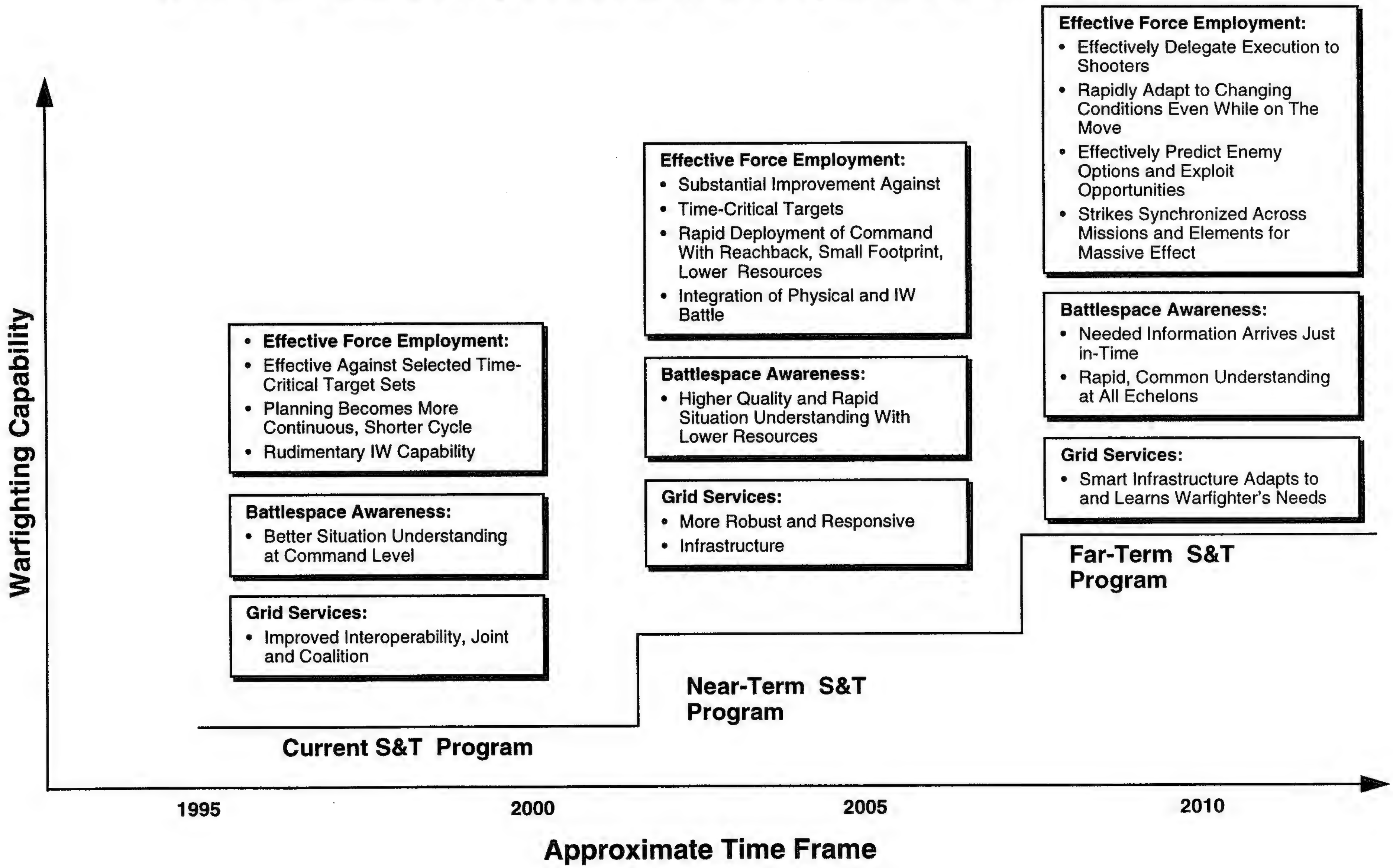
The preceding figure can be summarized in terms of the key elements within each incremental cycle.

In the first element, the operational and technical concepts and goals need to be aligned, demonstrated, evaluated, and adapted to provide the combination of "push" and "pull" necessary to advance the concepts and developments coherently. This effort includes not only establishing new operational concepts that can be tested in AWEs, but also assessing the feasibility for implementation of technology and new concepts in the time frame of the increment.

The second element is establishing processes to ensure the orderly introduction of new systems and concepts into the existing environment. Architecture is one of the key factors that enables smooth transition. New technology will introduce new operational and system capabilities and technical approaches, and may not be fully within existing architectural guidelines. Those departures need to be reviewed, and the mid- and long-term operational, system, and technical architectures need to be updated to accommodate them as appropriate. Interoperability with existing systems and processes is provided through a combination of architectural guidance and process reengineering. The new capabilities also need to be integrated with the plans and programs of the materiel commands. This is necessary to ensure that they are acquired and supported as integral parts of the total system of systems rather than inserted as stand-alone and unsupported segments.

In the third, and probably most important element, the new capabilities must be assimilated into the warfighters' educational and operational environment, both in operational and technical terms. The new concepts and systems need to be "baselined"—that is, they need to become formal, recognized parts of the mainstream education, doctrine, and training regarding both systems and operational concepts. The warfighters' concepts and processes need to be adapted to take advantage of new functions enabled by technology enhancement, as determined during the demonstrations and experiments. The warfighters need to be trained in these new concepts and processes, and the developers need to respond to lessons learned during training and exercise, to make necessary adjustments in the technical segments and to develop goals for the next increments.

Time-Phased Improvement in Operational Capability



Time-Phased Improvement in Operational Capability

Each step in the technology roadmap will provide a corresponding improvement in needed operational capability if integrated and fielded. This figure describes potential time-phased improvement leading to a fully realized ABIS by 2010.

Realization of the system level incremental improvements leading to the JCS joint vision of overwhelming dominance in the battlespace will require a continuing long-term commitment. These system efforts, coupled with the projected continued doubling performance of underlying information system hardware every 2 years, should result in significant incremental improvements in the warfighters' visibility and command of the battlespace as well as in the availability of accurate, detailed data needed for sensor-to-shooter concepts.

Between now and the year 2000, demonstrated capability improvements in force employment will be based largely on better target recognition and timely attack, beginnings of a defensive IW capability, and an improved planning capability. Battlespace awareness is to be improved by providing a consistent situational picture and an ability for integrated tasking of sensor assets. Grid capabilities will be improved to support rapid configuration of tactical networks and improved interoperability of radio networks.

In the midterm (2000-2005), further system improvements in force employment would be possible by wider dissemination of a commander's intent and improved C2 early in the campaign. Improved automated tools for weapon-to-target pairing and intelligence processing will allow substantial improvement against time critical targets. Battlespace awareness will be enhanced by continually projecting friendly and enemy moves and their outcomes, by adaptively supporting cognitive functions of diverse users, and by providing tailored information for mission execution when and where needed. Grid capabilities will be made more robust by advances in defensive IW, and by providing end users with an ability to tailor and adapt their information environment and access to information.

In the longer term (2005-2010), continued evolution of operational concepts and availability of new technology will provide a basis for full development of ABIS concepts.

Architectural Guidance

An Evolving Architecture "Continuum" to Provide Clear Guidance for Implementation and Flexibility for Longer Term Experimentation

- Provide Secure Interoperability and Functionality
- Manage Redundancies and Voids in Operational and System Capabilities
- Guide Insertion of New Functional Capabilities and System Features
- Provide Long-Term Guidance on Emerging Operational Concepts and Technologies

Architectural Guidance

Architecture, a central element in any operational or technical construct needs internal consistency and integrity. Architecture is the mechanism for setting the ground rules that ensure that each component can fit into the entire system to provide the required functionality. When we set out to change the construct over time, we need guidelines to ensure that the system is properly structured at any point in time and that the subsequent pieces can be connected to those that already exist.

This figure itemizes the principal needs for architecture. The bullets, which are self-explanatory, represent views on architecture that apply to guidance for each time frame. In the near term, we emphasize the secure interoperability and functionality. In the midterm, we focus on guiding and managing efforts to address currently perceived shortfalls, to economize on investments, and to insert new capabilities into the existing environment. In the long term, we provide guidance to the concept developers and R&D community to help align their initiatives with the objectives and evolving baseline systems to which they will need to connect. The following discussion provides additional insight into the role of architecture in ABIS evolution.

Although architectures are relatively static so as to provide continuity, they must also be open to change over time as operational needs and technological possibilities shift.

Architectures and System Design

- Operational Architecture
  - — Roles and Relationships of Organizations, and Information Flows
- Functional Architecture
  - — Processes and Their Relationships
- Technical Architecture
  - — Standards and Practices for Building Systems
- Physical Design
  - — Specific "Blueprints," Designs, and Hardware/Software Laydowns for Instantiation of Actual Systems

Architectures and System Design

Every discussion of architecture attempts to define a set of specific types spanning the operational and technical space. Major differences exist in the terminology used by different organizations, studies, and individuals, but the four categories listed in the figure span the areas listed in most such discussions and are recommended for standard usages. Architectures need to be relatively stable over meaningful lengths of time to accommodate evolving physical system instantiations. One key aspect of this is that architectures must be more generic than detailed system designs are.

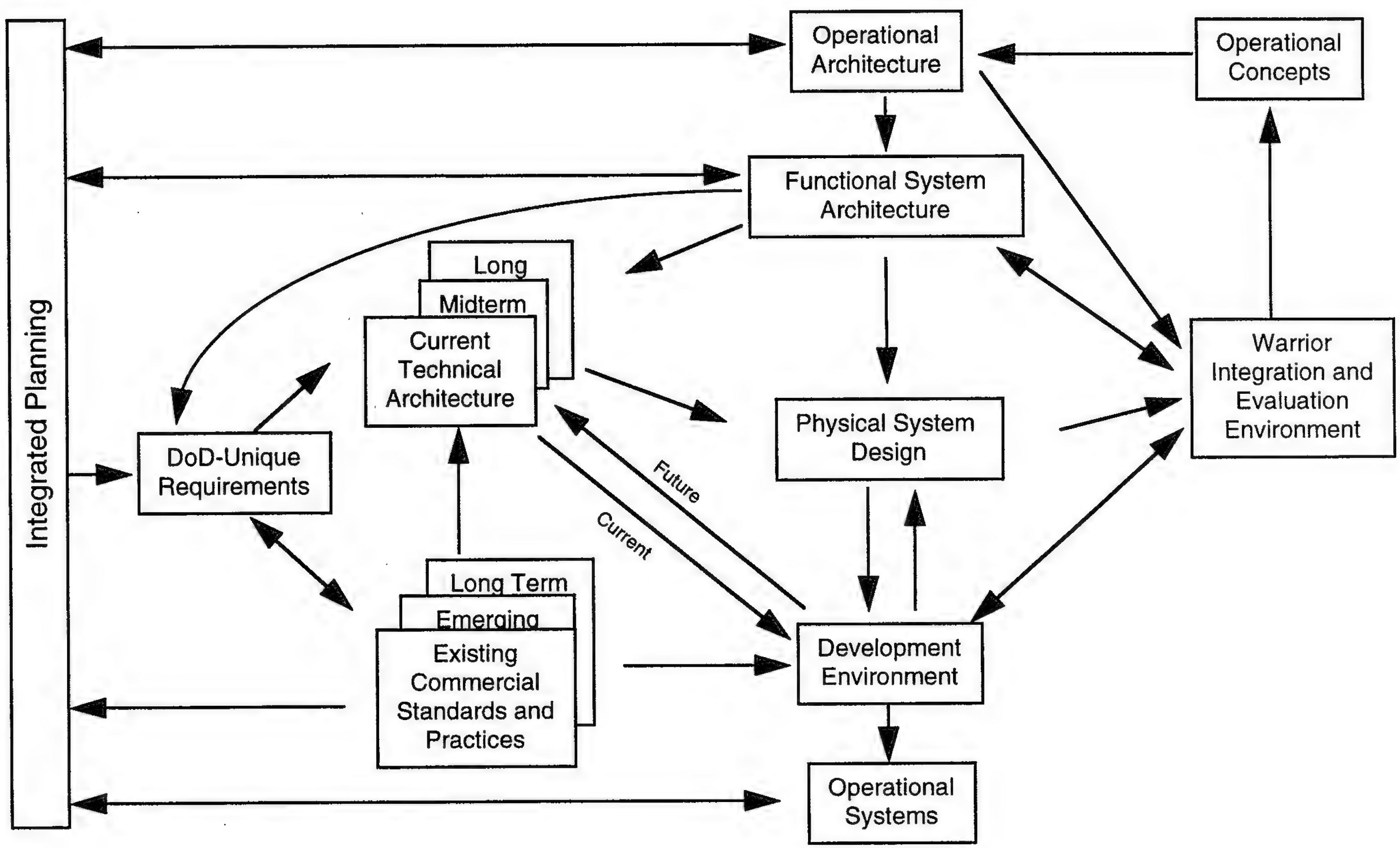
Operational architectures deal with the organization and relationships of the forces and their command and control elements. These architectures reflect operational doctrine, force structure, and operational and tactical organizations that govern the employment and sustainment of deployed forces. They provide the "operational framework" for the functional and technical implementations and are the fundamental basis for deriving requirements. Past practice frequently has regarded the operational architecture as "cast in concrete" and built inflexible systems to suit it. Practice has shown, however, that operational architectures evolve to take advantage of new technological possibilities and to accommodate new operational needs. The approach advocated by the ABIS Task Force and others in DoD is to allow the operational architecture to adapt to changes in the operational context and changes in the other architectures, and to allow all aspects of architecture to come into a mutually balanced "equilibrium" focused on warfighting capability, not predefined rigid organizational concepts and doctrines. This element is perhaps the most important in the evolution strategy.

Functional architecture deals with the processes needed to support the organizations and operations. The interaction among functional architecture and operational architecture is fundamental to "process reengineering," which is at the heart of the Revolution in Military Affairs. The functional architecture will evolve so that we accomplish the overall warfighting tasks better, and most likely in a manner different from current practice. Functional architecture depends on the technical feasibility of performing the functions in different ways, and the information technology revolution will directly influence this area. It will then feed back into the operational architecture, thus changing the basic organization and structure of the forces themselves.

Technical architecture, referred to as "building codes," defines standards and practices that, if used properly, ensure that the technical implementations have all the required functionality and qualities. Technical architecture assists the developers in building systems that support the functional and operational architectures.

Finally, system designs are the blueprints, wiring diagrams, and hardware/software laydowns that cause the functional and technical architecture to be implemented physically. System design follows the standards and practices defined in the technical architecture, implements functionality and interfaces as defined in the functional architecture, and builds capability in the way needed to support the operational architecture.

Architecture Based on Application and Concept Development With Feedback



Architecture Based on Application and Concept Development With Feedback

This figure is adapted from a recent study entitled "Integration and Modernization of Joint Land Warfare." The study was conducted by a team directed by CISA under tasking from ASD (C3I) and the Undersecretary of the Army. The figure is modified to illustrate the interactive nature of architectures with evolving technologies and operational concepts.

Operational and functional architectures are included in the "loop" in the upper right of the figure. This is the process reengineering that results in adaptation of operational concepts, operational architectures, and functional architectures. The process reengineering is supported by warfighting experiments that allow the users and developers to experiment with and evaluate new concepts that could be supported by current and emerging technologies. This notion of collaborative concept-technology experimentation and coordinated evolution of the operational and functional architectures is a core principle in ABIS evolution.

The "loops" to the left of the figure address the interaction of functional architecture with both the technical standards and practices and the real-world system design. The technical architecture, in turn, needs to be consistent with accepted commercial standards and practices and with emerging new standards and practices that could become important in the future. Technical architecture also needs to recognize that some military requirements may not be satisfied by the commercial marketplace.

The use of layered technical architectures implies that there can and probably must be different sets of guidance for different time frames. The three time-referenced technical architectures must ensure compatibility and interoperability as the system evolves, even though new features and standards may be implied in the future.

The vertical bar at the extreme left of the figure shows that overall planning needs to be integrated across the operational, functional, technical, and system areas to ensure that the areas are mutually consistent. The figure also shows that the commercial marketplace is a major driver in this planning and that the DoD-unique requirements are developed after careful consideration of the ability of commercial products to meet the demands of the functional architecture.

Concurrent Architecture Snapshots Focused on Three Time Frames

- Near-Term Focus
  - Legacy Migration and Convergence to Common Operating Environments
  - Interoperability
- Midterm Focus
  - Alignment of Objectives and Approaches for Technology Insertion
  - Formalized Framework for Evolution—e.g., GCCS/DISN LEE, TAFIM Extension
- Long-Term Focus
  - Guidance To Ensure That New Fielded Capabilities Are "Born Joint"
  - Alignment of DoD Initiatives With Commercial World

Concurrent Architecture Snapshots Focused on Three Time Frames

The ABIS architectures will evolve over time. At any point during that evolution, there will be varying views of architecture, depending on how far into the future we are looking. The three time frames identified in the figure represent a reasonable set of "snapshots" for architecture focus. Definition of time-phased focus does not imply that the near-term architecture is built first, followed by the midterm, and then the long term. All three exist simultaneously as part of the evolving "continuum" from the present toward the future. Each snapshot provides guidance to initiatives and programs that address the particular time frame—that is, the near-term architecture guides implementation; the mid term guides prototyping and demonstration for next increment implementations; and the long term guides R&D emphasis to keep the programs focused on commonly agreed objectives and approaches wherever possible.

In the near term, the most important factors are the maturity of operational concepts and technologies, and the needs for compatibility and interoperability with existing systems. Consequently, the near-term architecture must provide sufficiently specific guidance to ensure that either required functionality and interoperability are achieved, or risks associated with "disconnects" can be managed.

In the mid term, the architecture must provide clear guidance for insertion of new operational concepts and technologies that may extend beyond the scope of existing standards and practices. The framework for evolution to the next increment needs to allow some degree of flexibility so as to depart from legacy systems and concepts. It must also provide guidance to ensure that the departures can be fit into the current frameworks with minimum disruption, and that functionality and interoperability can be ensured or that risks associated with disconnects can be managed. As a result, the mid term architecture encounters two significant and competing challenges: to be consistent with existing frameworks and to provide totally new and different capabilities. In the mid term, it is expected that the operational architecture will be extremely similar or the same as in the near term. It is expected that the functional architecture will achieve some degree of process reengineering based on new concepts and technologies introduced during that time frame. The technical architecture would include some additions and modifications to the near-term architecture because of the introduction of new technical approaches and products. Finally, the system design plan would include new prototype systems connected to the legacy environment either directly or through some form of mediation or leading edge service provisioning.

The long-term architectures will be the least specific. The purpose is not so much to specify approaches but to coordinate approaches so that future systems are "born joint" and represent anticipated future commercial "state of the shelf" augmented by military-unique features and applications where necessary.

Evolving Architectures Enable Improvements and Paradigm Shifts

- Near-Term Architecture: Mainly Improvements in Procedures, Functional Processes, and Systems Components, Within the Framework of Existing Doctrine, Organization, and Force Structure
  - Some Procedure and Organization Changes, but Generally Consistent With Current Doctrine and Concepts
  - Major Improvement in Efficiency and Effectiveness of Current Practices
  - Reduction in Nonwarfighting Burdens (Smaller "Tail")

- Mid-Term Architecture: Adaptation of Operational and Organizational Concepts and Reengineering of Functional Processes, With Some Doctrinal Changes, but Minimal Change in Force Structure or Roles and Missions
  - Changes in C4I Concepts Consistent With Current Force Structure and Roles, Missions
  - Emphasis on Distributed, "Flattened" Staffs, and Integrated Joint Tactical Control/Execution
  - Introduction and Exploitation of Virtual Environments To Assist Decision Making

- Long-Term Architecture: Paradigm Shifts in the Fundamental Doctrine, Concepts, Roles, Missions, Organizations Leading to "Orders of Magnitude" Enhancements in Warfighting Effectiveness
  - Redefinition of the Battlespace as an Integrated Joint/Coalition Environment
  - Agile, Adaptive C4I for All Assets, Independent of Service
  - Agile, Adaptive C2 "Loops" Matched to Real-Time Needs Versus Formal Organizations
  - Emphasis on "Human-in-the-Automated-Loop" Processes Versus Humans in Control of the Automated Process

Evolving Architectures Enable Improvements and Paradigm Shifts

As ABIS evolves, capabilities will improve through incremental changes that represent improvements within the bounds of existing military thought and through other changes that cause fundamental revisions to doctrine, organization, roles, and missions.

Clearly, near-term changes must be reasonably consistent with existing military thought. Some paradigm shifts may be accommodated, but they would be related mainly to the way tasks are conducted within the overall framework of "strategy-to-task" as defined by existing doctrine and practice. Although reorganization of the task execution or restructuring of work flow could be accommodated, major organizational changes would be difficult.

The mid term offers opportunity for significant reengineering of the functional processes, including some degree of realignment of organizational roles and relationships. Fundamental doctrine, roles, and missions would remain consistent with emerging military thought, but some opportunities could open for exploration of stronger integration across service components and for "flattening" of command and control processes. As automation is introduced to augment and replace human staffs, the organizations that support each level of command may blend into a common, distributed staff organization that concurrently supports multiple commanders. The paradigm shifts in functional architecture would extend from the strategic level down to the deployed tactical forces.

In the long term, the goal is to explore and implement major paradigm shifts that redefine fundamental military thought. The creation of the U.S. Air Force after World War II is an example of a major paradigm shift brought on by a new technology. Emergence of information warfare and the evident need for strongly integrated combined arms forces may bring on a new set of paradigm shifts that change the doctrine, roles, missions, and organizations. The notions of speed of command and the "empty battlespace" and the ability to apply massive lethal force in the absence of massive physical presence may cause restructuring of the forces. For example, information-leveraged, light, agile vehicles that can call massive indirect fires may replace heavy armor on the future battlefield. Architectures must be broad and flexible enough to accommodate change without the need for a new architecture, except when the change is radical or unanticipated.

System-of-Systems Integrity Through Architecture Frameworks That Enable and Guide Progress

- Formalize a Set of Joint Near-, Mid-, and Long-Term Architectures Now
- Joint Mid-Term Architecture
  - Adapt the DISN/GCCS LEE as the Architecture Model and Focus on Improving Interoperability Significantly
  - Promulgate Emerging Standards and Practices for Extension of the TAFIM and Service Technical Architectures
  - Intensify DoD Participation in OMG and Other Emerging Technology Standards and Architecture Bodies
- Joint Long-Term Architecture
  - Closely Align With Commercial Technology Evolution
  - Identify Key Technology Areas and Ensure DoD Coupling to Commercial World
  - Establish Architectural Principles That Allow Sufficient Flexibility but Still Provide a Common Basis for the "Next Wave" Architecture
  - Focus Long-Term Architecture Development in the S&T Community Rather Than the Acquisition Community
- Develop DoD Process to Ensure That Long-Term Systems and Concepts Are "Born Joint"
  - Joint Battle Lab and Greater Integration of Service Battle Lab Activities
  - Use Joint Decision Support (Process and Center) to Evaluate C4I Initiatives From Joint Perspective
  - Establish Joint Capability Demonstrations for ATDs and ACTDs
  - Integrate Operational and Technical Planning and Architecture Efforts

System-of-Systems Integrity Through Architecture Frameworks That Enable and Guide Progress

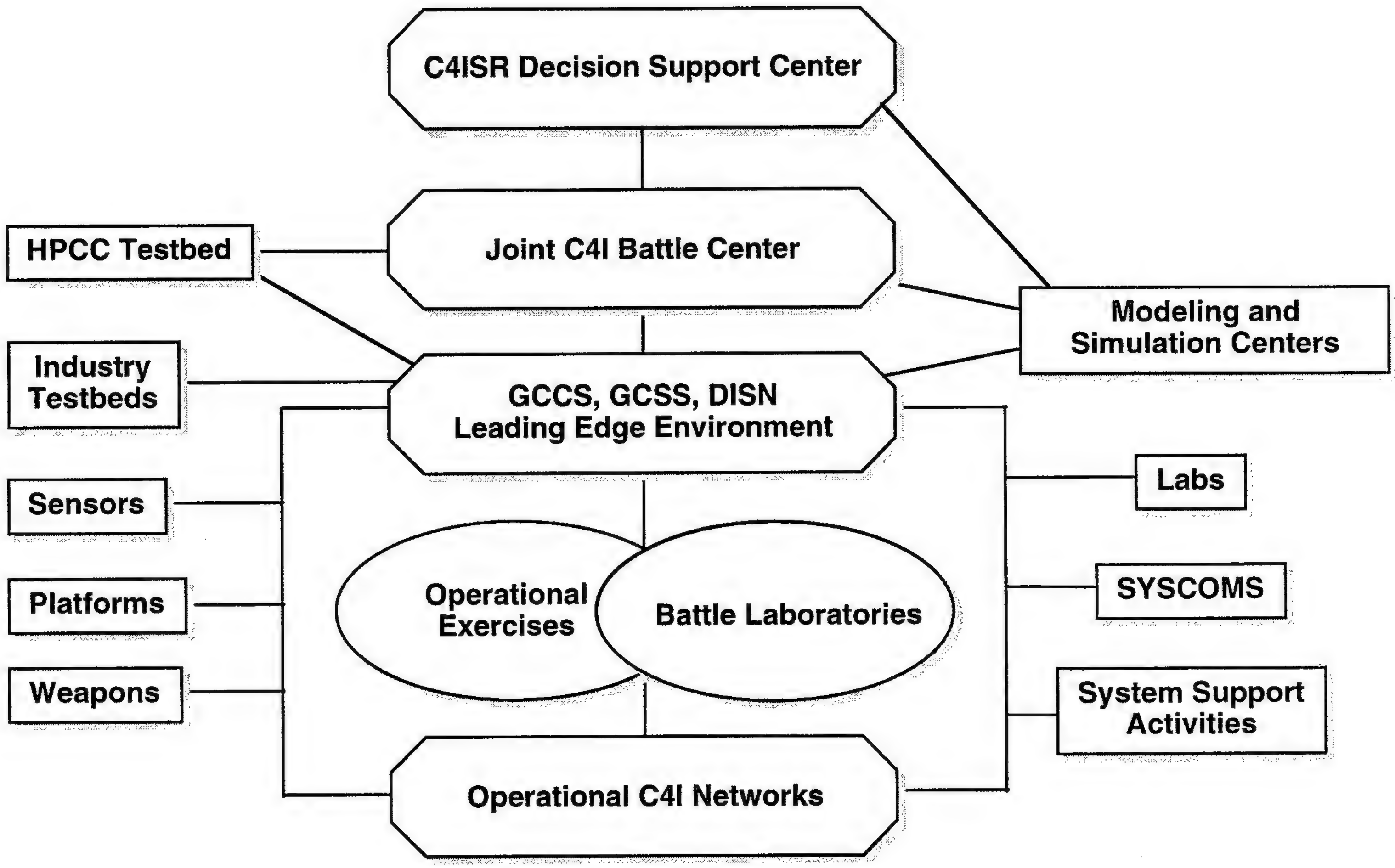
This figure summarizes the role of architecture in ABIS evolution. This set of recommendations helps expedite and guide movement toward the objective.

The first need is for a formal architectural framework consisting of a joint set of near-, mid-, and long-term architectures. Much recent emphasis within DoD is placed on near-term guidance, to bring legacy systems into alignment, and to point them toward common migration objectives. Now more emphasis needs to be placed on establishing a mid-term architecture that can help lead evolution toward next generation systems and concepts. For example, the Technical Architecture Framework for Information Management (TAFIM) is a framework that codifies current standards and practices. The TAFIM is not particularly useful to developers who are trying to build the next-generation systems beyond the bounds of the current framework. The TAFIM clearly needs to be augmented to provide a "draft framework" that can be used for the mid term and even for longer term initiatives. The same is true for DoD and service functional and technical architectures. The focus of the mid-term architectures should be on expediting the next increment and ensuring that it is compatible and interoperable with the current environment.

In the long term, DoD needs to establish dialog across all services and agencies to collaborate on objectives and approaches and to provide a unified interface with the commercial world. DoD must develop a coherent game plan for moving beyond the current "migration systems." In addition, the DoD needs to target technologies and potential standards that might become key elements in the future systems and to participate in developing draft standards and practices for applying them. Long-term architectural guidance needs to be flexible enough to allow innovation and clear enough to avoid totally uncoordinated, chaotic initiatives.

Finally, DoD needs to establish processes and mechanisms to ensure that rapid and innovative evolution produces systems that are "born joint." We cannot afford to have future legacy systems that need to be converged and migrated toward common standards. Interoperability and joint force functionality are best served if the systems and operational concepts are joint from the start. ABIS evolution envisions the use of joint warfighting experiments, joint battle laboratory constructs, and joint decision support mechanisms to help make this happen.

Extensive Use of Testbeds, Laboratories, and Exercises



Extensive Use of Testbeds, Laboratories, and Exercises

Continuous testing, evaluation, and feedback are central to the ABIS evolution strategy. Consequently, testbeds, laboratories, and exercises are key components of the process and would be used extensively.

This figure illustrates how existing and planned facilities can be united to establish a joint, integrated evolution support environment.

The C4ISR Decision Support Center and the Joint C4I Battle Center are new elements proposed by the Joint Staff and OSD. These centers would directly support joint and defensewide decision makers in developing concepts and technology evolution plans.

Service battle laboratories and operational exercises would work in collaboration with the joint facilities. They would be interconnected to form a virtual joint environment through a combination of operational C4I networks and the leading edge environment provided by ARPA and DISA. Warfighting experiments and exercises would be offered advanced technology C4I products and services through the leading edge environment, to augment advanced technology at their own locations. This process would allow warfighters to experiment with and evaluate a wide variety of new concepts and systems either directly or through the leading edge service brokers at the ARPA-DISA Joint Program Office.

Advanced technology products and support could be provided to the warfighting experiments and exercises from industry testbeds, modeling and simulation centers, and facilities such as the ARPA high performance computing and communications (HPCC) testbed or DoD laboratory testbeds. Leading edge communications could be used to connect these testbeds and laboratories to the warfighting experiments and exercises.

Sensors, weapons, and platforms could be connected similarly to the warfighters through the leading edge services and their normal communications. Advanced communications and processing could then be available for user evaluation as adjuncts to ordinary exercises because the existing and advanced technology capabilities would be available simultaneously.

Broad Community of Participants

- Provide Continual Feedback From the Field to the Planners and Developers of Advanced Operational Concepts and Technology
  - Refinement of Long-Term Objectives and Priorities
  - Balanced Focus on Near-Term Needs and Longer Term Goals
- Ensure That New Concepts and Technology Can Be Assimilated by the Operating Forces
  - Evolving Operational Concepts To Lead Insertion of New Technology
  - Adaptation of Training and Exercises To Build Expertise and Confidence
  - Full Life Cycle Support To Accompany Insertion of New Technology
- Collaborate With the Materiel Commands From the Start
  - Couple Advanced Technology Initiatives to Acquisition Strategies
  - Early Consideration of Life Cycle Support for Planned "Leave Behinds"
  - Collaborate on Movement Toward Accelerated Acquisition Processes

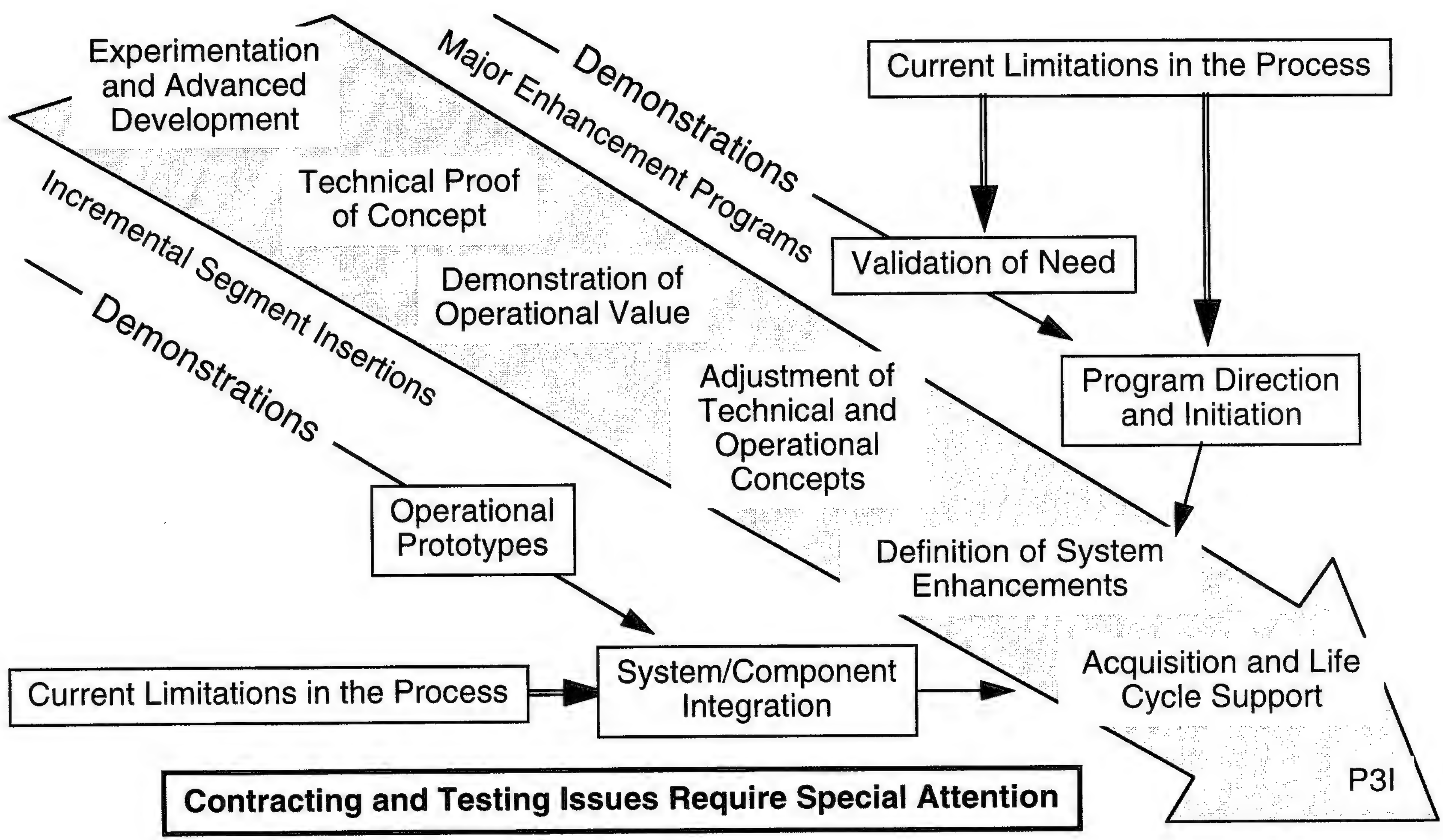
Broad Community of Participants

To integrate and assimilate the ABIS construct, it is essential to have a broad community of participants that establish and maintain close coupling between system users and system developers. It is also vital that the users' views align with those of the science and technology community. Further, the acquisition and materiel commands, throughout the DoD infrastructure, must coordinate and synchronize their efforts. This community acquires, fields, manages, and sustains the systems.

Assimilation of the emerging operational concepts and functional capabilities will require the close participation of doctrine, education, and training activities throughout the services, CINCs, and Joint Staff. It is important to adapt training and exercises to build expertise and confidence in the operator community.

There must be continual feedback from the field to the planners and developers of advanced operational concepts and technology. It is also crucial to accelerate acquisitions of state-of-the-art technology in a manner that ensures reliable life cycle support and end-to-end integrity and interoperability. Lastly, it is essential to have a balanced focus on both near- and longer term goals.

A Major Challenge: Improving the Acquisition and Modernization Programs



A Major Challenge: Improving the Acquisition and Modernization Programs

This figure illustrates two basic deficiencies in the current approach to accelerated acquisition. The shaded arrow from the upper left to the lower right identifies steps along the formal way to implementation and life cycle support of a new capability. The thin arrows above and below indicate two separate paths for accelerated, and often informal, acquisition, depending on whether the enhancement is a major new acquisition or simply a segment that can be inserted into an existing system.

For a large program, the demonstrations, evaluations, and prototyping can bring the initiative to a stage where it is judged operationally valuable and technically practical. The intent is then to enter acquisition without having to perform elaborate and time-consuming justification. The problem is that we still need formal validation of need and cost effectiveness and formal direction of the program. In the same way that a program executive officer or program manager cannot spend procurement dollars without formal documentation to justify the expenditures, the products cannot be tested, evaluated, and accepted without formal documentation of performance objectives. When a new capability package has been agreed to in the testbed environment, a process is necessary to quickly develop the "validation of need" documentation to replace current elaborate and time consuming requirements documentation and cost and operational effectiveness analyses (COEA). Abbreviated processes are needed to develop the program directives and operational test and evaluation (OT&E) objectives if we are to keep pace with the evolution of information technology.

For a smaller component, the questions related to formal documentation are not as important, although some documentation will still be required. The major problem here is with integration of a component into a system that is "owned" by an organization other than the segment developer. For example, ARPA may develop a planning tool that needs to be inserted into a service system. If ARPA works only with the service user or laboratory and not the actual implementer and supporter of the system, the component may not be accommodated technically, programatically, or organizationally.

Current processes must be adapted to accelerate acquisition and incremental evolution. The ABIS Task Force recognized this as a major problem that needs to be addressed by the acquisition community if the ATDs, ACTDs, and AWEs are to be successful.

Summary of the General Principles and Approach

- Coordinated Operational and Technical Evolution
  - Experimentation, Evaluation, and Feedback To Expedite and Validate New Concepts, Requirements, and Technical Approaches
- DoD Guidance To Enable and Expedite Progress
  - A Long-Term "Vector" Toward the Vision, With Incremental Goals
  - Integrated Operational and Technology Planning
  - Evolutionary, Time-Phased Joint Architecture
- Operational Concept Development To Assist Technology Assimilation
  - Concept of Operations To Lead Insertion of New Technology Into Operational Environment
  - Education To Train Users and Refine Concepts
  - Exercises To Build User Proficiency and Confidence
- Coordinated Technology Development, Acquisition, and Life Cycle Support
  - Early and Continuing Partnership With the Acquisition and Support Commands
  - Acquisition and Life Cycle Support Integral to Technology Initiatives

Summary of the General Principles and Approach

This figure summarizes the preceding discussion.

Integrated evolution of operational concepts and technology is the central concept in the evolution strategy. The use of experiments and demonstrations to provide continuous feedback and to replace the old, linear process is essential to keep pace with changing technologies and warfighting environments.

Guidance needs to expedite rather than impede progress, but it must also ensure coherence in the approach and interoperability and functionality in the products. We cannot attempt to "build" a long-term objective system as we have in the past. The long-term objective is a target on the horizon. Our initiatives must focus on near- and mid-term increments that point toward the objective and that help clarify and refine long-term goals with a framework of time-phased joint architecture.

Advanced operational concepts need to be brought into the baseline warfighting concepts, doctrine, and procedures so that the new capabilities can be assimilated by the fighting forces. We cannot train forces based only on past and current concepts and systems and then expect them to use the new systems and concepts effectively.

Finally, we must ensure that each new system or component developed under the accelerated acquisition strategy is properly integrated with the mainstream efforts of the materiel commands.

Specific Goals and Strategies for Moving Forward

The Revolution in Military Affairs and the Information Technology Revolution Require Us to Change the Way We Conduct Business

- Military Theory and Practice of Command
- Operational Concepts, Tactics, and Doctrine
- Technology Development Focused Closely on Users' Emerging Concepts and Requirements
- Military Application of a Wide Base of Information Technology
- System Constructs That Facilitate Assimilation and Flexibility of Use
- Changes in Processes to Facilitate Technology Insertion and Assimilation

Specific Goals and Strategies for Moving Forward

This figure lists six areas where DoD needs to develop specific approaches and where multiple organizations must participate to move toward the long-term ABIS objective.

The following figure provides initial thoughts in each area. These thoughts are not intended as definitive statements of the goals and approaches, but more as initial proposals to motivate thoughts within DoD as to the scope and breadth of changes that are necessary, and to begin the process of organizing to take appropriate actions.

Military Theory and Practice of Command

Goals

- Reducing the Size and Complexity of the Command and Control Hierarchy
- Lower Level Empowerment: Movement Toward Distributed Control, "by Intent," "by Negation"
- Just-in-Time Planning and Tasking: Satisfying and Actionable, Even If Not Fully Completed
- Integration of Force Management Across Operations, Intelligence, and Support Areas
- Collaborative Decision Making Instead of "Pass Down" Direction and "Pass Upward" Reporting
- Mixture of Analytical and Intuitive Decision Making: Judgment Informed by Analysis
- Continuous Forecast Assessment and Battle Management Instead of Rigid Sequential Cycles

Strategy

- Advanced Command Concept Curricula at Joint and Service Schools
- Advanced Command Concepts Wargame and CPX Series
- Use Warfighting Labs and Leading Edge Environments to Support Schools, Wargames, CPXs
- Emphasize Research on Cognitive Aspects of Intuitive Decisionmaking
- Use Simulation to Better Understand Predictive Situation and COA Evaluation

Potential Players

- CINCS
- Service Battle Labs
- Joint Battle Center
- Service Training and Doctrine Commands
- National Defense University
- Service Schools and Postgraduate Schools
- Military Operations Research Society

Military Theory and Practice of Command

The long-term objective envisions a major paradigm shift in the way that command is supported.

The listed goals indicate features that are different from current theory and practice. They imply flattening of the command hierarchy and integration across the services and across traditional warfighting and sustainment functional areas. Sequential processes will be augmented and eventually replaced by concurrent, parallel processes. Similarly, analytical decision making will be replaced by intuitive judgment that is informed by analysis but not fully constrained by analysis. Information management will also be far different from current practice. Instead of bundling information within the command and control process, it will be managed as a pooled resource, with direct access according to security controls and access privileges that are controlled by commanders.

The strategy to reach these goals emphasizes two major areas. One area is to educate and train personnel to develop, refine, and insert the new theories and practices at the commander and staff levels. The other is to introduce technology that demonstrates to commanders the power and efficiency of emerging technologies to support the new concepts.

The list of potential players is an initial identification of some key organizations that can help make this happen.

Operational Concepts, Tactics, and Doctrine

Goals

- Integrated Tactical Command and Execution Across Joint and Coalition Forces
- Application of Massive Force in Absence of Massive Local Presence in the "Empty Battlespace"
- Information as a Weapon: Deterrence Through Manifest Ability To Know and React
- Focus C4I To Support the Decision Makers (Commanders and Shooters)
- Self-Alignment of Distributed Decision Making and Action Based on Common Awareness
- Collaborative Battle Management and Execution
- Real Time Adaptation of Tactical Task Packages and Missions

Strategy

- Establish Multiservice Distributed Warfighting Laboratory With Leading Edge Services
- Provide Seamless Interfaces Between Simulation and C2 Systems to Provide "Vicarious Training"
- Integrate Operational, Intelligence, and Support Staff at Operational Level and Below: Current and Future Operations, Plans.
- Establish Common, Joint Taxonomies, Procedures, and Practices for Integrated Combined Arms Operations
- Emphasize Integrated, Joint Operations in Exercises and AWEs

Potential Players

- CINCS
- Service Battle Labs
- Joint Battle Center
- Service Training and Doctrine Commands
- Service Laboratories

Operational Concepts, Tactics, and Doctrine

The goals address three important areas:

- Integration of battle management and execution across joint and coalition forces
- Distributed, real-time coordination and direction of executing forces
- Leveraging information both to support the C4I processes and as a weapon in its own right.

The strategies imply substantial modification of current command structures to provide the high degree of integration and real-time responsiveness. Technology, education, and training will be required to provide warfighters with the tools and the expertise to conduct business in new ways.

Organizations that develop doctrine and concepts and that train the warfighters need to be key participants, as do laboratories that provide the technologies.

Technology Development Focused Closely on Users' Emerging Concepts and Requirements

Goals
- Increased Effectiveness of DoD RDT&E Expenditures in Terms of Overall Force Capabilities
- Precise Targeting of Critical Technology Areas to Enable Future Concepts
- Expediting the Lab-to-Shelf-to-Field Cycle by Building Potential User Concepts in From the Start
- Integration of DoD S&T Strategy and Program Into JCS and Service Concepts and Plans

Strategy
- Close Partnership Between J3/J6 and DDR&E Development, as in the ABIS Task Force
- Common Documentation of Operational and Technical Objectives
- Increased Contribution of DoD Labs and Materiel Organizations to the Requirements Oversight Process
- Increased Contribution of Operational Community to DoD S&T Program Planning
- Increased Focus of JWF S&T Strategy and Defense Technology Area Plans (DTAPS)

Potential Players
- Joint Staff
- OSD
- Joint Battle Center
- C4I Decision Support Center
- Service Training and Doctrine Commands
- Service Battle Labs
- ARPA
- Service Laboratories

Technology Development Focused Closely on Users' Emerging Concepts and Requirements

The goal is to align the DoD science and technology program with the overall vision and to establish operational capability objectives as the drivers for S&T investments and priorities. This goal implies developing both the operational concepts and the technology initiatives as integrated packages and evaluating the investments in terms of overall force capabilities.

The strategy is continued expansion of the process begun during the ABIS study, during which the operations and technology participants collaborated to develop a joint, integrated vision. One output of the study was documentation that enabled the operators and technology developers to prepare and evaluate plans. This type of common documentation needs to be formalized and disseminated to laboratories, materiel commands, concept and doctrine organizations, and training organizations.

Military Application of a Wide Base of Information Technology

Goals

- U.S. Forces Operating With State-of-the-Shelf Commercial Capabilities
- Reductions in C4I Staff Levels Through Automation and Streamlining: at Least 50 Percent by 2005
- Versatile, Adaptable HCI to Suit All Operational Environments, Styles, and Preferences
- Ability To Cope With Massive, Often Uncertain or Ambiguous, Battlespace Information
- Ability To Manage Forces and Assets Unimpeded by Shortfalls in Information Management or Understanding

Strategy

- Use Warfighting Labs as Proving Ground for Insertion of Technology and Adaption of Systems and Processes
- Provide Automation To Accomplish Routine Tasks and Gain User Confidence as Replacements for Staff
- Make Day-to-Day Information Technology Environment Identical to Deployed Warfighting Systems Environment
- Focus ATDs on Feasibility, ACTDs on System and Concept Adaptation and Evaluation
- Focus on Aggregate Operational Capability Packages of Multiple Technology Demonstrations
- Establish Partnership With Industry To Help Evaluate and Adapt Commercial Technologies

Potential Players

- Service Battle Labs
- Joint Battle Center
- C4ISR Decision Support Center
- Service Training and Doctrine Commands
- Advanced Information Technology JPO
- ARPA and Service Laboratories
- Industry Laboratories and Testbeds

Military Application of a Wide Base of Information Technology

The goal is to leverage commercial information technology to increase the force effectiveness and efficiency. An ability to insert and assimilate state-of-the-shelf commercial capabilities and to build systems that can adapt to the needs and preferences of the users is part of the strategy. Automation should not only improve effectiveness, but also allow the replacement of people. This commercial technology helps make the forces more agile because less lift would need to be devoted to moving C4I systems and staffs to the forward area. It also reduces personnel and support costs. Commercial technology should also provide means for the decision makers to deal with massive amounts of information that will be provided from a wide variety of sensors and repositories. Industry is dealing with similar problems of massive, distributed, heterogeneous information and can be expected to develop products that can be inserted into DoD systems.

The strategy is to develop intensive experimentation at DoD warfighting laboratories and in combined DoD-industry testbeds to gain visibility of emerging commercial products and of the ways that they can be used to improve effectiveness and efficiency. The notion of replacing humans with computers and of relying on distributed rather than local, organic staffs will need to be internalized over a period of time, not simply inserted into the operational environment. Commercial technologies for distributed virtual workspaces are starting to emerge and to find acceptance. Military applications of these technologies have begun to arise at the operational level of command, through initiatives sponsored by ARPA, the service laboratories, and several CINCs. Efforts to bring advanced commercial technologies into the mainstream DoD C4I development processes need to be expanded.

System Constructs That Facilitate Assimilation and Flexibility of Use

Goals

- Ability To Accommodate a Wide Range of Plug and Play Configurations, Matched to the Force Packages
- Seamless Interoperability Between Existing and Future Systems
- Decoupling Processes and Procedures From "Hard Wired" Systems
- Embedded Assistance To Train and Develop Proficiency

Strategy

- Forward Compatibility Through Technology Insertion To Accommodate New Capabilities
- Develop Time-Phased Architecture That Extends From Present to Long Term
- Mandate Open System Standards and Practices Consistent With Commercial Practice
- Establish Common Taxonomy and Models for Information: Data Elements, Objects, and So On
- Design Systems To Facilitate Unplanned, Contingency Interfaces and Reconfigurations in the Field

Potential Players

- Military Communications and Electronics Board
- OSD (C3I/CISA)
- Service Battle Labs
- Joint Battle Center
- C4ISR Decision Support Center
- ARPA and Service Laboratories
- Networked Interservice Interoperability Testbeds
- Agencies: DISA, DIA, NSA, NRO, DARO, DMSO
- Advanced Information Technology JPO
- Service Materiel Commands

System Constructs That Facilitate Assimilation and Flexibility of Use

The goal is to provide systems that the user can adapt to changing requirements, processes, and preferences. Current systems are designed relatively rigidly to implement specific and narrowly defined operational and functional architectures. In many cases, these are stovepipe systems that represent a predetermined operational and organizational construct, usually within a specific service or geographic area of operations. We need to provide systems that are more readily adapted to the force composition and the C4I processes that the warfighters determine are appropriate for a given situation at that time. We need interoperability at the level of functional and physical modules, not just the ability to move information across boundaries between systems. We also need interoperability among legacy systems and new systems so that each element of the integrated system of systems can function with the others. In addition, we need embedded tools, such as training and troubleshooting aids, to help users gain expertise and operate the systems during training, exercise, and real-world actions.

The strategy is to establish technical architectures that are not tied too closely to the current functional or operational architectures and to provide built-in mechanisms for evolving and expanding the current architecture frameworks. The notion of “forward interoperability” rather than “backward interoperability” is useful here because it allows sufficient freedom to design the next generation system and provides interoperability through off-the-shelf mediators that can bridge from the legacies to the future environments. The architectures must include standards for this type of mediation or for other “bridging” techniques that might be applied. The functional and technical architectures need to emphasize modular designs rather than “top to bottom” vertically integrated systems. Applications and processes need to be decoupled from data (or objects), and modules need to be able to be assembled to match the wide variety of force packages.

Changes in Processes to Facilitate Technology Insertion and Assimilation

Goals

- Achieve Speed of Command in the Field
- Lead Any Adversary in Insertion and Assimilation of Useful Commercial Capabilities
- Operational Concept, Doctrine, Procedural Evolution on Pace With Technology Insertion
- Time From Shelf-to-Field Consistent With the Technology Obsolescence Cycle
- Achieve "Sharper Tooth, Shorter Trail" by Minimizing Unnecessary "Paper Trails"
- Orchestrate Acquisitions and Enhancements Across All Services, as Truly Joint Initiatives

Strategy

- Emphasize "Speed of Command" as an Element of Combat Power in Joint and Service Schools
- Achieve Timely Capabilities Consistent With a Best Fit of Technology to Operational Priorities: "the 80 Percent Solution"
- Speed Program Justification by Using Interactive Operational-Technical Experimentation
- Practice Evolutionary Development and Fielding, Including T&E and Contracting
- Design Systems To Facilitate Frequent Upgrades

Potential Players

- OSD (USD/ACQ, C3I/CISA)
- C4ISR Decision Support Center
- Military Communications and Electronics Board
- Service Battle Labs
- Training and Doctrine Commands
- Service Materiel Commands

Changes in Processes to Facilitate Technology Insertion and Assimilation

The goal is to reduce the time from shelf to field and from concept to operational practice to match the pace of technology change and to ensure that the systems are "born joint." This effort is essential to ensure that U.S. forces can operate as integrated organizations and can stay ahead of any potential adversary in leveraging the commercial marketplace.

The strategy involves three main thrusts. First, we need to focus integrated operational-technological enhancements on the operational benefits that have the highest payoff and that can be implemented most readily. This will often involve achieving an 80 percent solution with emerging off-the-shelf technology rather than spending time and money to achieve another 10 or 15 percent. Second, we need to streamline the acquisition process and eliminate much of the "paper trail" by using hands-on test, evaluation, and validation of operational need and suitability. Third, we need to treat all C4I acquisitions as joint activities and bring them all under the cognizance of an integrated planning, management, and architecture process.

Annex E. Sponsor Letters of Invitation, Task Force Organization, and Membership

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

JUN 30 1995

MEMORANDUM FOR DEPUTY UNDER SECRETARY OF DEFENSE (ADVANCED TECHNOLOGY)
DEPUTY ASSISTANT SECRETARY OF THE ARMY (RESEARCH AND TECHNOLOGY)
CHIEF OF NAVAL RESEARCH
DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE (RESEARCH AND ENGINEERING)
DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY
DIRECTOR, BALLISTIC MISSILE DEFENSE ORGANIZATION
DIRECTOR, DEFENSE NUCLEAR AGENCY
DIRECTOR FOR FORCE STRUCTURE, RESOURCES AND ASSESSMENT

SUBJECT: Future Global Battlefield Information System for JCS Vision 2010 (System of Systems)

There is going to be a JCS/DDR&E sponsored study to be held this summer (August 2 to October 22, 1995). Using the JCS Vision 2010 operational concept as a context, this study will identify operational solutions, needs or capabilities and match them against technology-based systems, capabilities or services being developed in the DoD Science & Technology Program that may meet those operational needs in the future. Particular attention will be paid to demonstrations -- both Advanced Technology Demonstrations and Advanced Concept Technology Demonstrations from across DoD. The effort will involve both the joint military users and the technologists.

As you know, the JCS Vision 2010 operational concept envisions a system of systems comprising three major functional components: precision force, battle awareness, and information superiority that are integrated to provide overall battle dominance. Vision 2010 foresees the capacity to use military force with greater precision to achieve more effectiveness with less risk. The key technology building blocks for Vision 2010 include precision guided munitions; integrated intelligence; surveillance and reconnaissance; global communications; C2 systems; distributed planning information systems; global and theater sensor nets; and information warfare.

The study will focus on the information system and technology aspects of Vision 2010. The main objective of the study effort is to define more precisely the operational capabilities that must be delivered with the help of information systems and to identify the specific demonstrations and specific technology developments that enable the military to achieve those capabilities. This study is a focused activity intended to build a more effective relationship between the military and the technologists and to assure that envisioned operational concepts are aligned with technology development programs and demonstrations. The attached copies of slides will provide more concrete information.

Adm. Art Cebrowski and I are planning this study. I invite you to nominate a couple of your leading technologists in the information systems area to participate. We will select participants to ensure coverage of the technologies and current demonstrations of interest, and to ensure adequate representation of the components.

Anita Jones

Attachments

THE JOINT STAFF
WASHINGTON, DC

AUG 9 1995

Reply ZIP Code:
20318-6000

MEMORANDUM FOR DISTRIBUTION

Subject: Advanced Battlespace Information Task Force

1. Recent work in precision strike concepts and requirements highlighted the need for a coordinated strategy and roadmap for a comprehensive battlespace information structure. The Advanced Battlespace Information Task Force is a group which is being established to assist in the execution of the Vice Chairman's 'System of Systems' Initiative and provide the requisite strategy and direction. Our objective is to constitute this group no later than the end of this month and report out by mid-December.

2. The Advanced Battlespace Information management structure must service all types of operations at all levels of conflict. The overall concept envisions an integrated C4ISR grid which will provide essential capabilities in the areas of strike, protection, logistics, maneuver and information superiority. It focuses on advanced technologies to enable multiple and simultaneous operational and command concepts while creating a supportive technology roadmap. We need to make the operational vision an explicit part of the science and technology program and identify critical technology demonstrations which support the vision.

3. As a result, the Director of Defense Research and Engineering, Office of the Secretary of the Defense, and I have established and will co-chair the Advanced Battlespace Information Task Force. The structure of the Task Force will include a senior OSD/JCS executive panel, a general officer/SES review group, a secretariat, three working groups, and an advisory group composed of industry experts. I briefed this approach to the Precision Strike/Intelligence, Surveillance, and Reconnaissance COSG on 7 June 1995, and they were fully supportive. I invite your organization to participate in this effort.

4. The initial meeting of the Task Force is 21 September 1995, 0830-1700, location to be determined. A read-ahead package outlining the rationale for the initiative, proposed organizational structure, and a proposed task breakdown will be provided prior to the meeting. I ask you to identify your general officer/SES (one or two-star level) review group representative, as well as two working group representatives from your organization who can participate in the study and represent your interests and perspectives. Please provide the names of these individuals to Ms. Renee Potter at (703) 696-2424 by COB 25 August 1995.

Subject: Advanced Battlespace Information Task Force (continued)

5. Please note Dr. Anita Jones, DDR&E, has forwarded a corresponding invitation to the Science and Technology community. Admiral William A. Owens, Vice Chairman, Joint Chiefs of Staff has endorsed this initiative.

6. I thank you in advance for your organizational and personal support.

AK Cebrowski

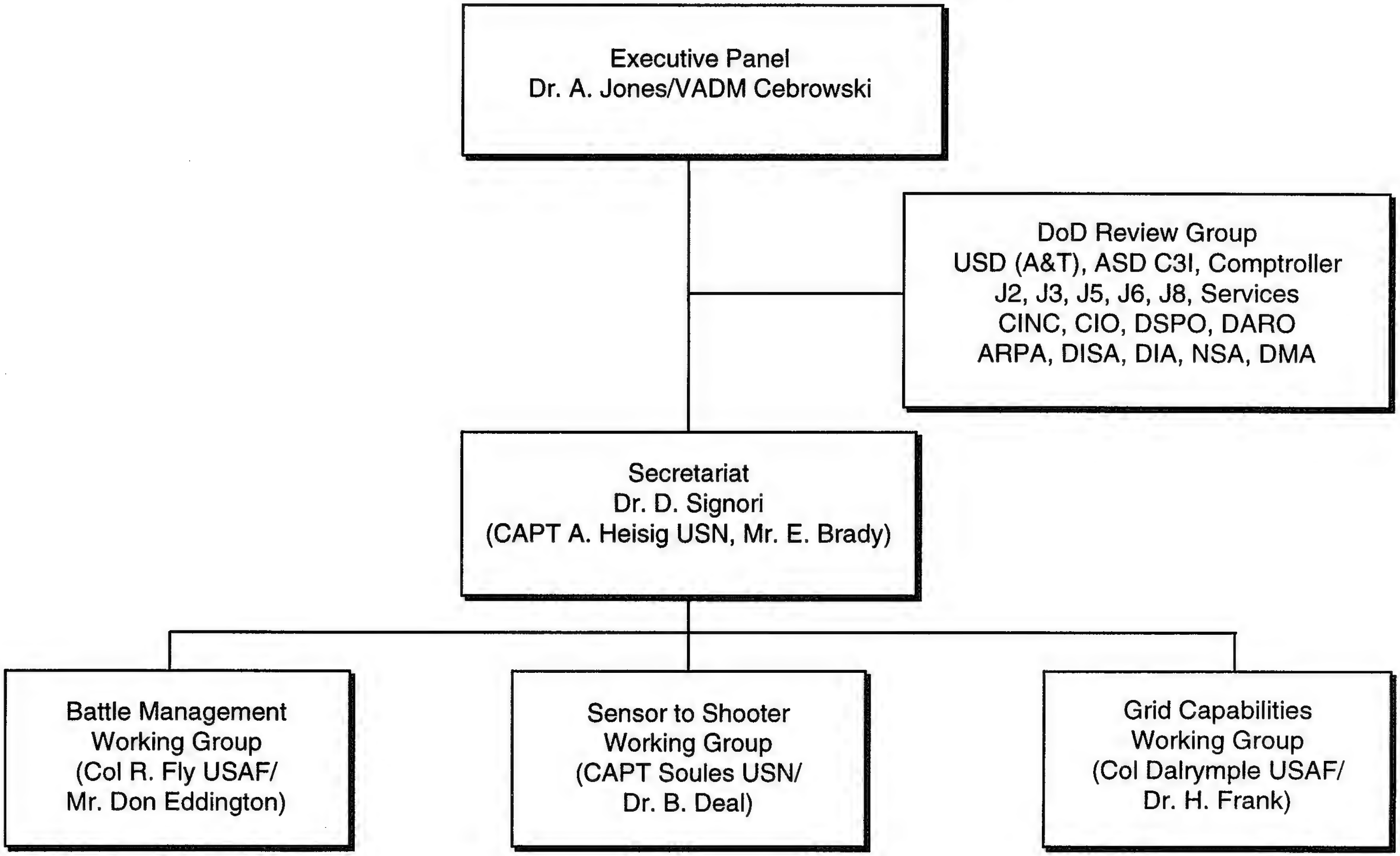
ARTHUR K. CEBROWSKI
Vice Admiral, USN
Director for Command, Control, Communications, and Computer Systems

Distribution:

PRINCIPAL DEPUTY UNDER SECRETARY OF DEFENSE (COMPTROLLER)
PRINCIPAL DEPUTY ASSISTANT SECRETARY OF DEFENSE (C3I)
DIRECTOR, DEFENSE RESEARCH AND ENGINEERING
DIRECTOR, PROGRAM ANALYSIS AND EVALUATION
DIRECTOR OF THE ARMY STAFF (DACS-ZD)
ASSISTANT VICE CHIEF OF NAVAL OPERATIONS (N09B)
ASSISTANT VICE CHIEF OF STAFF, US AIR FORCE (CVA)
DIRECTOR, MARINE CORPS STAFF (DMCS)
DIRECTOR, CENTRAL IMAGERY OFFICE
DIRECTOR, DEFENSE INFORMATION SYSTEMS AGENCY
DIRECTOR, DEFENSE INTELLIGENCE AGENCY
DIRECTOR, DEFENSE MAPPING AGENCY
DIRECTOR, NATIONAL SECURITY AGENCY
DIRECTOR, DEFENSE AIRBORNE RECONNAISSANCE OFFICE
DIRECTOR, NATIONAL RECONNAISSANCE OFFICE
DIRECTOR, DEFENSE SUPPORT PROJECT OFFICE
DIRECTOR, INTELLIGENCE (J2)
DIRECTOR, OPERATIONS (J3)
DIRECTOR, STRATEGIC PLANS AND POLICY (JS/J5)
DIRECTOR, OPERATIONAL PLANS AND INTEROPERABILITY (JS/J7)
DIRECTOR, FORCE STRUCTURE, RESOURCES AND ASSESSMENT (J8)

ABIS TASK FORCE ORGANIZATION AND MANAGEMENT STRUCTURE

Study Management Structure



The Secretariat

- Serve as Orchestrator and Integrator for Working Groups
  - Methodology
  - Operational Framework (e.g., Scenarios)
  - Overall Systems Concept
  - Integrated Technology Roadmap
  - Evolution of ABIS
  - Integrated Final Report
- Manage Core Contractor Support
- Provide Administrative Support

The Secretariat

The Secretariat had three major roles in the ABIS Task Force Study (September 1995 to May 1996): It was responsible for the overall aspects of the effort from analytic approach to a common integrated product. It was the overall program manager of both the core contractor support and the specific technical work conducted by the Secretariat itself. It provided the overall administrative support to the task force effort. Much of this work was done through the mechanism of an Integration Team that included the co-chairs of the working groups as well as many members of the Secretariat.

The Secretariat was composed of 14 members from the DoD and industrial contractors. The Secretariat membership is listed on the following page. DoD representatives are listed first, then contractor personnel. The Executive Secretary and Deputy Executive Secretary of the ABIS Task Force were, respectively, Dr. David T. Signori, Jr. of the Advanced Research Projects Agency (ARPA) and Mr. Edward Brady of Strategic Perspectives Inc. (SPI). They were also the Director and Deputy Director of the Integration Team.

Secretariat Membership

Participant	Organization
Dr. David Signori	ARPA (Executive Secretary, ABIS Task Force and Director, Integration Team)
CAPT Alan Heisig	JS/J6
Col Roy Edwards	JS/J6
Dr. David Albert	National Defense University
Mr. Edward Brady	Strategic Perspectives Inc. (Deputy Executive Secretary, ABIS Task Force and Deputy Director, Integration Team)
Dr. Kenneth Jordan	SAIC
Dr. Ann Jones	The MITRE Corp.
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Battle Management Working Group

- Major Area of Emphasis: Precision Force in MRC
  - Shape Battlespace
  - Control Pace of Battle
  - Integrate Force Execution
- Develop Operational Concepts and Capability Objectives for Supporting Information Systems
  - Force Management and Coordination
  - Mission Planning and Direction
  - Management and Tasking of ISR and C3 Assets
  - Integration Across the Major Functional Areas
- Identify Key Packages of Enabling Technologies
  - Emerging Information Technology-Related Services
  - Current Demonstrations and Prototypes
  - Additional Future Needs
- Develop Time-Phased Technology Roadmap

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Sensor-To-Shooter Working Group

- Major Emphasis on Engagement of Mobile and Time-Critical Targets
  - Maneuver Units
  - Aircraft and Missiles
  - Counter-Force/Counter C4I
- Develop Operational Concepts and Capability Objectives for Information Systems
  - Execution Management
  - Targeting, Cueing, and Guidance Support
  - Rapid BDA and Restrike
- Identify Key Packages of Enabling Technologies
  - Emerging Information Technology-Related Services
  - Current Demonstrations and Prototypes
  - Additional Future Needs
- Develop Time-Phased Technology Roadmap

ABIS Sensor-to-Shooter Working Group

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Grid Capabilities Working Group

- Major Areas of Emphasis
  - Project an Assured Global Battlefield Information System Capability
  - Operate Through All Phases of Force Deployment
  - Major Emphasis on Common Support Services
- Develop Operational Concepts, Technical Framework and Capability Objectives for the Core System and Services
  - Defensive Information Warfare
  - Dynamic Management of Networks and Services
  - Knowledge-Based Information Filtering, Correlation, Retrieval and Resource Support
  - Distributed Computing Environment Architecture
- Identify Enabling Technologies
  - Emerging New Information Technology Related Services
  - Current Demonstrations and Prototypes
  - Additional Future Needs
- Develop Time-Phased Technology Roadmap

Grid Capabilities Working Group Membership

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Annex F. Glossary

ABCC	Airborne Command and Control
ABCCC	Airborne Command and Control Communications
ABIS	Advanced Battlespace Information System
ACTD	Advanced Concept Technology Demonstration
AD	Air Defense
AOC	Air Operations Center
AOR	Area of Responsibility
App	Application (usually refers to automated applications)
ARPA	Advanced Research Projects Agency
ATACMS	Army Tactical Missile System
ATD	Advanced Technology Demonstration
ATM	Asynchronous Transfer Mode
ATO	Air Tasking Order
ATR	Automated Target Recognition
AWACS	Airborne Warning and Control System
B-ISDN	Broadband Integrated Services Digital Network
BADD	Battlefield Awareness and Data Dissemination
BDA	Battle Damage Assessment
BM	Battle Management
bpp	Bits Per Pixel
C2	Command and Control
C2I	Command, Control, and Intelligence
C2W	Command and Control Warfare
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance
CDC	Combat Direction Center
CEC	Cooperative Engagement Concept
CEOI	Communications and Electronics Operating Instruction

CINC	Commander-in-Chief
CJTF	Commanders, Joint Task Force
CMA	Collection Management Authority
CMW	Compartmented Mode Workstation
COA	Course(s) of Action
COE	Common Operating Environment
CONOPS	Concept of Operations
CONUS	Continental United States
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off the Shelf
CP	Command Post
CVW	Collaborative Virtual Workspace
DBC	Digital Battlefield Communications
DBMS	Database Management System
DCE	Distributed Computing Environment
DDR&E	Director, Defense Research and Engineering
DISA	Defense Information Systems Agency
DMS	Defense Message System
DSP	Defense Support Program
DTAP	Defense Technology Area Plan
DTO	Defense Technology Objective
ECCM	Electronic Counter-Countermeasures
ECM	Electronic Countermeasures
ELINT	Electronic Intelligence
EMI	Electromagnetic Interference
EO	Electro-Optical
ESM	Electronic Support Measures
FLIR	Forward Looking Infrared

FST	Fire Support Team
FTX	Field Training Exercise
GBS	Global Broadcast System
GOTS	Government Off the Shelf
HAE UAV	High-Altitude Endurance Unmanned Aerial Vehicle
HCI	Human-Computer Interface
HTACC	Hardened Tactical Air Command Center
IAW	In Accordance With
ID	Identity or Identification
IFF	Identification, Friend or Foe
IMINT	Imagery Intelligence
Infosec	Information Security
IP	Internet Protocol
IPB	Intelligence Preparation of the Battlefield
IR	Infrared
ISAR	Inverse Synthetic Aperture Radar
ISDN	Integrated Services Digital Network
ISR	Intelligence, Surveillance, Reconnaissance
IT	Information Technology
ITO	Integrated Tasking Order
IW	Information Warfare
JBC	Joint Battle Center
JCPMS	Joint Communications Planning and Management System
JFACC	Joint Force Air Component Commander
JFC	Joint Forces Commander
JFLCC	Joint Force Land Component Commander
JFMCC	Joint Force Maritime Component Commander
JIC	Joint Intelligence Center
JIT	Just in Time

JPEG	Joint Photographic Experts Group (Standard)
JROC	Joint Requirements Overnight Council
JSTARS	Joint Surveillance and Target Acquisition Radar System
JTF	Joint Task Force
JWCA	Joint Warfighting Capability Assessment
KCOIC	Korean Command Operations/Intelligence Center
LRC	Lesser Regional Conflict
M&S	Modeling and Simulation
MASINT	Measurements and Signatures Intelligence
MC&G	Mapping, Cartography, and Geodesy
MILSATCOM	Military Satellite Communications
MLRS	Multiple Launch Rocket System
MLS	Multilevel Security
MMW	Millimeter Wave
MOE	Measure of Effectiveness
MRC	Major Regional Conflict
MRL	Multiple Rocket Launcher
MTI	Moving Target Indicator
NRT	Near Real-Time
NTM	National Technical Means
O&M	Operations and Maintenance
OIW	Operations/Intelligence Workstation
OPLAN	Operation Plan
OPSEC	Operations Security
OTAR	Over-the-Air Rekeying
OTH	Over the Horizon
PGM	Precision Guided Weapon
POM	Program Objective Memorandum
RDT&E	Research, Development, Test, and Engineering

REECE	Reconnaissance
RMA	Revolution in Military Affairs
ROE	Rules of Engagement
RT	Real-Time
S&T	Science and Technology
SA	Situational Awareness
SAR	Synthetic Aperture Radar
SAS	Survivable, Adaptable System
SATCOM	Satellite Communications
SIGINT	Signals Intelligence
SOF	Special Operations Force
SONET	Synchronous Optical Network
SSCN	Secure, Survivable Communications Network
STS	Sensor-to-Shooter
TAC	Tactical Air Controller
TAP	Technology Area Plan
TBM	Theater Ballistic Missile
TCP	Transaction Communications Protocol (used with IP)
TCT	Time-Critical Target
TEL	Transportable Erectable Launcher
TFCC	Task Force Command and Control
TLAM	Tomahawk Land Attack Missile
TOC	Tactical Operations Center
TOT	Time Over (or On) Target
UAV	Unmanned Aerial Vehicle
VCJCS	Vice Chairman Joint Chiefs of Staff
VTC	Video Teleconference